STRESS, COPING AND COFFEE CONSUMPTION

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RATLIFF-CRAIN

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
F. EDWARD HÉBERT SCHOOL OF MEDICINE
4301 JONES BRIDGE ROAD
BETHESDA, MARYLAND 20814-4799

GRADUATE EDUCATION

TEACHING HOSPITALS
WALTER REED ARMY MEDICAL CENTER
NAVAL HOSPITAL, BETHESDA
MALCOLM GROW AIR FORCE MEDICAL CENTER
WILFORD HALL AIR FORCE MEDICAL CENTER

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Jerome E. Singer Committee Chairperson	30 August 1991 Date
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Jeffrey Ratliff-Crain
Department of Medical Psychology
Uniformed Services University
of the Health Sciences

Abstract

Title of Dissertation: Stress, coping, and coffee consumption

Jeffrey Alan Ratliff-Crain, Doctor of Philosophy, 1991

Dissertation directed by: Andrew S. Baum, Ph.D., Professor, Department of Medical Psychology

Coffee, the most common source of caffeine, is a suspected risk factor for heart disease and use during stress is of particular concern. Using an experimental manipulation of stress, coffee consumption and use of coffee for coping with stress were examined. Internal analyses of self-reported patterns of usual coffee and caffeine consumption and reactions to the manipulations were used to identify individual differences in coffee consumption. The hypotheses that situations perceived as controllable increase use of problem-focused coping and uncontrollable situations increase use of emotion-focused coping were tested in order to investigate possible coping purposes for coffee use.

Using a 2 X 2 factorial design, high and low performance demands were crossed with presence or absence of uncontrollable noise in a sample of moderate to heavy coffee drinkers ($\geq$3 cups of coffee/day). Demand was manipulated by payment contingency: payment for work completed versus salary with no minimum performance specified. Mood, coping strategies, physiological responses (heart rate and cortisol), and coffee consumption were monitored. Coffee

and herbal tea were freely available to all subjects and volumes consumed during sessions were calculated. Decaffeinated coffee was used in order to test coffee independent of caffeine.

The demand and noise manipulations resulted in increased negative mood, but not changes in coping or coffee consumption. Desire for control and perceived control were positively associated with use of problem-focused strategies whereas perceived demand and reported upset were positively associated with use of emotion-focused strategies. Use of emotion-focused coping and level of noise-related upset were negatively associated with coffee consumption in the laboratory. Conversely, feelings of helplessness were positively related to coffee consumption.

Internal analyses were conducted on groups formed by self-reported usual patterns of caffeine consumption during stress. These revealed that subjects who reported generally using more caffeine when experiencing stress consumed more coffee in the laboratory, especially when more problem-focused strategies were used and under situations where they felt uncomfortable or helpless. The remaining subjects tended to consume less coffee under these conditions. This study indicated that person-situation interactions govern stress-related coffee consumption patterns.

STRESS, COPING, AND COFFEE CONSUMPTION

by

Jeffrey Alan Ratliff-Crain

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DEDICATION

To Sharon and Devon, who always remind me of what is really important in life.

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A large number of people, both directly and indirectly, have made this dissertation, and what it represents, possible. I find it difficult to properly acknowledge the support, teaching, inspiration, and friendship that have been given to me by my family, colleagues, friends, and teachers. Nothing I could say here would do justice to what they have provided me. Suffice it to say that I am grateful.

The dissertation ends up with only one name on the binding-- as if this was something that I dreamed up, cooked up, and whipped into shape myself. Were it not for the members of my dissertation committee, I do not believe that this project could ever have been as successful as I now believe it is. I'd like to take this opportunity to thank Jerome Singer, Neil Grunberg, Ann Norwood, and Andy Baum for the insight, expertise, hard work, and patience that they provided for this project. I have learned a lot.

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Introduction

The present study examined in a laboratory setting the hypotheses that (1) stress leads to increased coffee consumption in regular coffee drinkers and (2) coffee drinkers use coffee as part of a coping response to stressful or anxiety-provoking situations. Additionally, this study investigated the relationships among perceptions of control and coping behaviors. An experimental manipulation of stress and self-report information regarding coffee drinking patterns and other individual differences were used to test these hypotheses.

The most obvious use of coffee, as the most common source of caffeine, during stress is to facilitate actions necessary to deal with an event itself (a problem-focused approach). However, people who regularly drink coffee report positive mood effects, relief from negative feelings and moods, and have been found to respond to challenge more favorably when caffeine has been consumed, raising the possibility that it can serve emotion-focused purposes as well (Goldstein, Kaizer, & Whitby, 1969; Graham, 1988; Ratliff-Crain, O'Keeffe, & Baum, 1989). By manipulating levels of performance demand and superimposing uncontrollable noise over the task situation, this study assessed changes in consumption and the underlying purposes for those changes during stress. It was reasoned that if facilitation of

performance was the only purpose for increased coffee use during stress, then consumption should increase with greater performance demands, whether stress related to exposure to uncontrollable noise was low or high. Conversely, if caffeine serves some emotion-focused purposes, then situations producing greater stress, unrelated to performance demands, would also be expected to increase consumption.

Both stress and caffeine have been implicated as possible risk factors for illness. The similarity between the effects of caffeine and the sympathetic activation that generally accompanies stress has recently led to speculation about the increased potential for ill effects that these may hold when experienced in combination (Lane, Adcock, Williams & Kuhn, 1990; Lane & Williams, 1985, 1987; Myers, Shapiro, McClure & Daims, 1989; Pincomb, Lovallo, Passey, Brackett & Wilson, 1987; Strickland, Myers, & Lahey, 1989). Not only may the physiological effects of stress exacerbate the effects of caffeine, or vice versa, but stress may also lead to increased consumption of caffeine, thereby increasing the simultaneous exposure of two sources of sympathetic activation. However, the ways that stress may affect consumption of caffeine have not been studied in a laboratory setting.

The aim of this review and study was to clarify the roles that stress may play in the consumption of caffeine and to test the hypothesis that stress leads to increased coffee consumption in a controlled laboratory experiment. In order

to understand the effects of stress on behavior, the different parts of the stress process need to be taken into account. As will be subsequently discussed, the ways in which stress is responded to depends on several factors of the situation such as its perceived controllability and resources available to the stressed individual.

Stress, Coping, and Perceived Control

Stress

Stress is a complex psychophysiological process involving an initiating event (a stressor), the appraisal of that event as threatening or as taxing, and the responses made (Baum, Singer, & Baum, 1981). As a process, stress is not a static state, but one that changes continually as interpretations and events change and as actions are taken. There are a number of variables that intervene between the experience of an event and the state that is referred to here as stress. While there are events that could be considered as threatening to almost anyone experiencing them, most events do not fall into such an extreme category. Instead, interpretations of day to day events involve appraisal based on experience, resources, other current stresses, and a host of other variables.

Appraisal is an ongoing process used not only for initial interpretations of whether an event is threatening or not, but also as a way to monitor change in the situation, determine if the threat is one that can be dealt with given

available resources, and to evaluate the efficacy of current actions made to counteract the stressor (Lazarus & Launier, 1978). Appraisal of events, then, not only plays a role in determining subsequent reactions but also in shaping how one may cope with an event. Because of these intervening variables it would not be expected that every person exposed to the same situation would react to it in exactly the same way or that long-term consequences would be equal across individuals. In sum, consideration of more than just the characteristics of a particular event is needed to determine if one is experiencing stress.

Stress, as described by Selye (1956; 1976), has been viewed as a general adaptation response, identical across all stressors, leading eventually to a stereotypic set of pathologies. This General Adaptation Syndrome (G.A.S.), was made up of three phases-- an alarm reaction, an adaptation stage, and an exhaustion stage. The G.A.S. was typified by a triad of morphological changes, including adrenal cortical enlargement, atrophy of the thymus, and ulcerations of the stomach and duodenal lining. The uniformity of this response triad to all stressors has been the focus of some debate with other researchers noting variability in patterns of neuroendocrine and cardiovascular responses depending on the characteristics of a stressor or challenge (cf., Mason, 1975a,b; Obrist, 1981). The implication is that the body is readied differentially depending on the interpreted needs of the situation and the associated emotional responses.

Most responses to a stressor, both physiological and behavioral, can be seen in terms of readying an individual to cope with a stressor (Ratliff-Crain & Baum, 1990). Physiological responses characteristic of the stress response are those that are generally associated with the fight or flight response, originally described by Cannon (1927). These physiological changes, such as increased sympathetic activity with associated increases in blood pressure, heart rate, and catecholamine and cortisol release, are those that result in more efficient energy usage and general increases in readiness for action (Mason, 1975b). These are often accompanied by psychological changes that may also be facilitative for responding to threatening events such as narrowing of attention and increased alertness as a result of mood changes such as anxiety (Easterbrook, 1959; Lazarus & Folkman, 1984).

The physiological changes associated with stress have been implicated as possible etiological factors in illness. Stress related increases in blood pressure and alterations in hormonal levels may lead to changes in cardiovascular and immunological functioning, representing possible direct effects on health (Krantz, Glass, Contrada, & Miller, 1981). Of all of the possible ways that stress may effect health, the ways that psychological factors may affect risk for cardiovascular disease have received the most attention (Krantz & Manuck, 1984). Physical strain placed on the cardiovascular system by increases in blood pressure and metabolic demands as well as related biochemical insults have been the

focus for studies of mechanisms behind cardiovascular disease. These have been studied primarily with comparisons of individual difference factors (e.g., Type A behavior pattern, family history of heart disease or hypertension) and/or by using reactions to acute or chronic stress as a model of the processes involved (e.g., Schneiderman, 1983).

There are two aspects of the cardiovascular responses that can accompany stress that are of greatest concern. The first is the increased work output of the heart related to increased blood flow (greater force exerted at systole and increased heart rate). The second is the resultant increase in metabolic demand by the heart that would need to be offset by greater delivery of oxygen via the coronary arteries. Increased blood pressure has been suspected as a mechanism for injury of the endothelium of arteries, especially at bifurcations, from the "shear stress" and turbulence that is created (Gorlin, 1976) while the increased demands of the heart can be dangerous if the system is otherwise compromised.

Biochemical changes occurring during stress, especially in combination with the physical damage to arteries, is thought to be a necessary component for development of atherosclerosis (Glagov, 1971; Ross & Glomset, 1976; Schneiderman, 1983). The hypothesized role of catecholamines is that they increase the mobilization of free fatty acids and other lipids in excess of metabolic requirements (Carruthers, 1969). These lipids in combination with smooth muscle cells and platelets, can create

lipid-filled lesions at sites of injured endothelium, referred to as atheromatous plaque (Gorlin, 1976; Krantz & Manuck, 1984; Ross & Glomset, 1976). Excess lipids and cholesterol can then accumulate at the base of this plaque, interfering with the blood supply of living cells, resulting in calcifications, further blockage of the artery and finally clinical complications related to decreased blood supply (e.g., ischemia, myocardial infarction or sudden death) (Krantz & Manuck, 1984; Schneiderman, 1983).

One way that researchers have been able to study how stress may lead to the physiological changes thought to initiate or contribute to cardiovascular disease has been to evaluate the changes seen in response to acute stressors and challenges (reactivity). An underlying assumption in the study of reactivity is that changes observed in acute challenges can act as an index of pathogenic processes (Krantz & Manuck, 1984). As will be noted further, different stressors, depending on how they are interpreted and the type of action taken to deal with them, may result in different patterns of physiological response.

A number of attempts have been made to characterize the different physiological responses found to accompany different challenges. Obrist and colleagues, for example, have noted that challenges requiring effort are generally accompanied by increased sympathetic activity with associated increases in heart rate, systolic blood pressure and increased catecholamine output, whereas stressors not requiring an

active response have been noted to result in increased diastolic blood pressure (c.f., Obrist, 1981). These expected patterns of response have not always been found with challenges that otherwise appear to be distinguishable by Obrist's criteria (e.g., Contrada et al., 1982; Manuck, Harvey, Lechleiter & Neal, 1978). More recently, differences in receptor activation have been noted during exposure to different types of challenges, including increased activation of beta-adrenergic receptors, increasing cardiac performance, during situations requiring more active responses and greater alpha-adrenergic receptor activation during other, sometimes referred to as "passive," situations (Sherwood, Allen, Obrist & Langer, 1986; Sherwood, Dolan & Light, 1990). The sources of the different responses to these challenges have not been discovered, making the distinctions between types of tasks difficult to interpret. In sum, these distinctions are not absolute and often both types of reactivity are observed, however they have been useful for attempting to understand the variety of ways that stress may affect health. The more effort-related tasks, also commonly referred to as "active coping" tasks (Obrist, 1981), have been the only type used in studies of caffeine and stress thus far (Lane et al., 1990; Lane & Williams, 1985, 1987; Myers et al., 1989; Ratliff-Crain, O'Keeffe & Baum, 1989; Strickland, Myers & Lahey, 1989).

In addition to cardiovascular disease, evidence has accumulated regarding the role of stress in immune function.

Evidence for a connection between psychological influences on the immune system come from both the animal and human literature (Borysenko & Borysenko, 1982; Jemmott & Locke, 1984). Mechanisms point to both humoral processes as well as effects of direct innervation. For example, cortisol is known for its anti-inflammatory and otherwise immunosuppressive effects and receptors have been found for catecholamines and other stress-relevant substances on lymphocytes, which evidence suggests have immunoregulatory effects (Bishopric, Cohen, & Lefkowitz, 1980; Claman, 1972; Crary, Borysenko et al, 1983; Crary, Hauser et al, 1983, Fauci, 1978; Strom & Carpenter, 1980; Williams, Snyderman, & Lefkowitz, 1976; Wybran, Appelboom, Famaey, & Govaerts, 1979). The implication is that many of the factors important in the role of stress in development of cardiovascular disease (e.g., sympathetic reactivity) also have immunologic implications. Whereas clinically significant effects are not as easily monitored in acute stress or challenge situations, recent studies of acute stressors, such as course examinations taken by medical students, have shown marked changes in a variety of immunological parameters consistent with the generalization of immunosuppression (Glaser et al., 1985; Glaser et al., 1987; Glaser, Rice, Speicher, Stout, & Kiecolt-Glaser, 1986; Kiecolt-Glaser, Garner, Speicher, Penn, & Glaser, 1984).

Stress and the potential for understanding psycho-social contributions to disease etiology have continued to be issues of interest with stress-related research showing marked

increases over the past two decades (Vingerhoets & Marcelissan, 1988). However, despite continued advances in measurement techniques and methodology, stress remains an imprecise concept (Baum, 1990). Among the areas of stress research that have seen recent theoretical development is the area of cognitive appraisal and coping, discussed in the following section.

Coping

Stress can have indirect health effects as well as the direct mechanisms outlined previously. Primarily these effects are observed through behaviors made in response to stress either as a way to cope with it (e.g., substance use (Wills & Shiffman, 1985)) or as a result of changes that have occurred because of stress (e.g., increased food intake in response to stress, (Herman, 1988)). Even when coping strategies are effective at terminating the source of stress, coping may involve "costs." These could take the form of exhaustion from trying to work too hard to compensate for demands or health effects associated with the particular coping behaviors chosen. In this section, coping will be defined and some of the issues affecting the choice of coping behaviors used will be explored.

Coping has been defined as "constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (Lazarus & Folkman,

1984, pg. 141). The greater the demands, the greater the need for mobilization to counter them, leading to greater potential costs along with greater likelihood of failure (Lazarus & Launier, 1978). Responses made to deal with demands can alter the situation in order to lessen the demand (problem-focused coping) or to reduce negative emotions associated with the demand (emotion-focused coping) (Lazarus, 1966). More often than not these forms of coping are used together when dealing with stressors; few people appear to use one at the exclusion of the other (Folkman & Lazarus, 1980; Lazarus & Folkman, 1984). This makes sense because most stressful situations contain both emotional and challenging components. Also, these categorizations of coping are not mutually exclusive. For example, actions that reduce tension may facilitate the ability to take action against a stressor, and being able to take constructive action against a stressor would likely lead to improved affect. In spite of this overlap, the distinctions are useful for categorizing actions taken in response to stressors.

The effectiveness of one type of coping over another is at least partially determined by the characteristics of the stressor. In a study of life changes reported by Billings and Moos (1981), active attempts to deal directly with problems associated with a stressor were more effective for maintaining normal levels of functioning than when avoidance or emotion-focused methods were used. Somewhat different findings have been reported for subjects dealing with a

chronic stressor over which they did not feel they had much control. Subjects at Three Mile Island using primarily emotion-focused coping exhibited lower levels of stress than those using denial or problem-oriented methods (Collins, Baum, & Singer, 1983). Yet another study found that the use of denial by subjects dealing with an acute surgical stress resulted in more favorable outcomes (Wilson, 1981). Therefore, it is not appropriate to conclude that there is one overall effective coping strategy. The situation clearly interacts with personal predispositions and the stressor to determine the effectiveness of any particular strategy.

Particular coping behaviors may be affected by the type of stressor, personal factors, and other environmental or social constraints. One such behavior is substance use. As a coping behavior, substance use has generally been conceptualized as an emotion-focused response with drugs being used to escape negative feelings and/or arousal as well as to increase positive feelings (Alexander & Hadaway, 1982; Wills & Shiffman, 1985). Though they do not decrease actual demands, use of drugs is thought to increase to counteract the negative emotions and physiological arousal associated with stress. The importance of maintaining an optimal level of arousal is implied with mood predicted to be more positive when stress-related physiological arousal has been diminished.

It is possible, however, that substances are taken to help facilitate the actions necessary to overcome demands. For example, stimulants may be taken for a number of problem-

focused reasons-- weight loss, staying awake, and so on. Determining whether drugs are taken as a form of coping and identifying the reasons particular drugs are chosen for different situations may prove to be a very useful way to study coping in general and the possible health costs that may be associated with it.

Perceived control

One of the factors determining mode of coping is perception of control. Control, in this sense, is the belief that one can influence the aversiveness of a stressor (Thompson, 1981). It is important to note that this definition of control does not require that action be taken, but simply the belief that the option is available and feasible is adequate. Perception of control has been shown to mitigate some of the negative psychological and physiological consequences of stress even if the actions needed to take control of the situation are not made (cf., Glass & Levy, 1982; Glass & Singer, 1972). However, perceptions of control may be affected by certain aspects of the stressor as well as differences associated with the individual, such as previous experience. For example, an unpredictable stressor would be difficult to control because knowing when a stressor is going to occur aids in the ability to either prevent or preempt it, however predictability does not guarantee controllability (Weinberg & Levine, 1980). Likewise, previous failure in attempting to control one

situation may affect perceptions of control in subsequent situations, as has been observed with learned helplessness (cf., Seligman, 1975).

That controllability of environmental factors can affect level of reported stress has been found outside of the laboratory as well, primarily in work settings. Johansson, Aronsson and Lindstrom (1978), comparing Swedish sawmill workers, found that those who had little control over the pace or content of their work were more dissatisfied with their jobs and had greater urinary epinephrine levels than those workers who had more personal influence over how their work day was designed. This is consistent with a model proposed by Karasek, Russell, and Theorell (1982) who hypothesized that jobs that are high in demand and low in control are more stressful, and therefore potentially a health risk factor. In two case-control studies, one prospective and the other cross-sectional, it was found that workers in jobs with a hectic schedule and with little control over the work tempo or variety exhibited significantly greater risk for coronary heart disease or myocardial infarction (Alfredsson, Karasek, & Theorell, 1982; Karasek, Baker, Marxer, Ahlbom, & Theorell, 1981).

Controllability of stressors may not only affect appraisal of stress and subsequent physiological and psychological reactions to it, but also what coping behaviors are chosen to deal with stress. The most effective way to terminate the effects of a stressor is to remove the stressor

itself. This would tend to become more difficult in situations that were less controllable. Given an uncontrollable event, dealing with the effects of the stressor or its consequences, including the negative emotional effects, would be the only reasonable alternative. Therefore, it has been suggested that problem-focused approaches are used more if situations appear to be amenable to change whereas emotion-focused approaches would predominate in situations perceived as unchangeable (Folkman & Lazarus, 1980).

While being a face valid concept, most of the evidence regarding the relationship between perceived control and coping behaviors has been indirect with no clear evidence that coping behaviors change in response to appraisals of control. In one study, couples were interviewed monthly for six months about the most stressful event that had occurred during the immediately preceding week (Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 1986). Subjects were asked to rate to what extent the event was one in which they "...could change or do something about", and the extent that they "...had to accept" it. The relationships among secondary appraisal as represented by these questions, which are conceptually similar to perceptions of control, and each of the eight coping options of the Ways of Coping scale were analyzed. In encounters that were reported as being changeable, subjects accepted more responsibility and used more confrontative coping, planful problem-solving, and positive reappraisal whereas encounters that were perceived as ones that had to be

accepted, distancing and escape-avoidance behaviors were more common.

In a projective test of the same concept, Torestad, Olah, and Magnusson (1985) asked 203 seventeen year-olds to rate how predictable, controllable, and anxiety provoking each of 20 situations would be and then describe in their own words what they would do if they encountered each of the situations. These descriptions were then rated as being constructive, passive, or escape solutions to the situations. In this study, constructive coping was conceptually similar to problem-focused coping. Passive coping included emotion-focused solutions where no attempt was made at moving away from the situation, and escape coping referred to behaviors and cognitive acts resulting in moving away from the situation either psychologically or physically, and was therefore a combination of problem and emotion-focused strategies. They found that greater anxiety resulted in decreased reporting of constructive coping and increased escape coping with no changes in passive coping. Additionally, the more that predictability and controllability increased, the more constructive and the fewer escape and passive coping behaviors were chosen. The patterns of results indicated that under high predictability and high controllability, constructive coping was preferred approximately three times as often as the other two strategies while under low predictability and controllability, the strategies were virtually identical in preference.

Unfortunately, with the use of imagined situations it is unclear how accurate the predicted outcomes would be and there may be more of a tendency to over predict constructive responses and under predict the passive or escape responses.

Examination of coping styles over time and across differing events has not always led to confirmation of the control-coping model, however. In one study where subjects were interviewed at a four-month interval, a tendency was also found for emotion-focused coping strategies to be used more when events were not perceived as being amenable to change (Patterson et al., 1990). That same study, however, failed to find a connection between perceived changeability and use of problem-focused techniques. Furthermore, women diagnosed with breast cancer were found to use more escape-avoidance styles of coping when perceptions of control were low, but correlations between perceptions of control and planful problem-solving were not significant (Hilton, 1989).

While Patterson et al., (1990), found situational control to be predictive of coping more so than coping strategies used in previous situations, individual or other differences may still determine responses in natural events examined in correlational studies. One recent test of the connection between control and coping in a controlled laboratory setting provided evidence supporting the model proposed by Folkman and Lazarus, (Sullivan & Weisse, 1989). In this study, subjects were exposed to shock accompanied by noise while seated behind an apparatus that had a button and

two lights. They were instructed that there was a way to stop the noise and that one light on the apparatus would inform them that they had found the solution, the other would light if it was incorrect. However, only half of the subjects were given the opportunity to find a correct solution (pushing the button four times after two-minutes of noise and shock within seven seconds), the other half were always given feedback of an incorrect response no matter what they did. Subjects were paired in a yoked design to insure that the uncontrollable stress subjects were not exposed to different levels of noise and shock than the controllable stress group.

Coping behaviors, as measured by a modification of the Ways of Coping scale, were assessed in response to the laboratory stress. Subjects reported using a greater number of coping responses when exposed to uncontrollable stress, primarily emotion-focused responses. No differences were found between controllable and uncontrollable stress groups for use of problem-focused strategies, however subjects in the controllable session made significantly more button presses in response to the stimuli than when in the uncontrollable session, indicating greater behavioral effort in response to this type of situation. The lack of ambiguity or complexity involved in the solution to the stressor described by Sullivan and Weisse (1989) may account for fewer numbers of problem-focused strategies being employed in that particular case. A more complex, yet controllable, situation may have lead to greater numbers of problem-oriented strate-

gies being used.

Together, these studies indicate that numbers of different emotion-focused coping strategies increase during uncontrollable situations. Additionally, because of the overall increase in both types of strategies, uncontrollable stressors seem to be accompanied by a search for possible solutions-- both problem and emotion focused. The pattern of this search is unclear but the major focus does seem to be in the direction of more emotion regulation. Number of problem-focused strategies used, however, may or may not be affected by controllability of the stressor, although some evidence exists to support the hypothesis that more effort is placed into these strategies when stress is perceived as being controllable.

Whereas these studies far from prove that controllable stress leads to problem-focused behaviors or that uncontrollable stress leads to emotion-focused behaviors, they do reflect tendencies for shifts in those directions. Of course actions taken will also depend on factors other than simply whether a stressor could possibly be controlled or not. McCrae (1984), in a study of coping with life events, found threatening situations or ones involving loss were associated with greater emotion-focused strategies with an emphasis on trying to forget the negative, and challenging situations resulted in both problem and emotion-focused responses, with the emotional regulation emphasizing the positive. Therefore, factors such as perceived costs associated with either

attempting or not attempting to alter the situation will affect what type of action is taken as well.

In sum, stress is thought to negatively affect health via physiological changes and indirectly through behaviors. Of primary interest here are the effects related to sympathetic arousal and the factors that can affect physiological reactions and coping responses to an event. Specifically, the perceived controllability of an event appears to have an impact not only on how stressful it may be appraised, but also seems to affect the strategy of coping used. These attributes of the stress process will be reflected in the following sections on the pharmacological properties of caffeine and the ways in which coffee is consumed.

Effects of Caffeine

Caffeine is a mild stimulant found in a number of common foods and medications, with coffee accounting for approximately 80% of the total caffeine consumption in the United States (Gilbert, 1984). Estimates suggest that 75-92% of the U.S. population consumes some caffeine, with over half of adult Americans consuming at least the equivalent of two to three cups of coffee per day (Gilbert, 1984; Gilliland & Bullock, 1984; Roberts & Barone, 1983). Consumption of caffeine is particularly heavy in Western countries with Canadian consumption similar to that of the U.S. and the United Kingdom and Sweden consuming about twice that amount

(Gilbert, 1984). It is a drug that is unique in its acceptability and commonality of use-- very few other drugs are given to children as a treat in the form of beverages (colas) or food (chocolate bars). One U.S. study of 1135 children 5 to 18 years old, using diaries of food consumed over a one week period, found 98% of them had consumed an average of 37.4 mg caffeine per day over that time (Morgan, Stults, & Zabik, 1982). This common availability and acceptability of caffeine has lead to a complacency relative to other drugs regarding possible psychological and physiological effects associated with its use.

A methylxanthine, caffeine is a central nervous system (CNS) and skeletal muscle stimulant (Gilbert, 1976). It is completely absorbed from the gastrointestinal tract, reaching peak plasma levels within 30 to 120 minutes after ingestion (Bonati, Kanto, & Tognoni, 1982; Robertson et al., 1978). Caffeine is widely distributed throughout the body without any specific tissue binding, freely passing the blood-brain barrier and the placenta (Bonati & Garattini, 1984; Burg, 1975). Only 5% of caffeine is eliminated unchanged with the rest metabolized primarily by the liver with the plasma half-life ranging from 1.5 to over 9 hours (Bonati et al., 1982; Smits, Thien, & van't Laar, 1985). Because of caffeine's pharmacokinetics, its effects are wide and varying depending on dose and length of time from ingestion.

Whether caffeine can be considered an addictive and hazardous substance is a debate that has resurfaced

periodically (cf., Austin, 1979; Gilbert, 1976; Griffiths & Woodson, 1988). Part of the evidence indicating that caffeine is a potentially addictive drug is that tolerance and dependence appear to develop quickly and withdrawal symptoms appear upon termination of use (Griffiths & Woodson, 1988). Headache, fatigue and lethargy, and general discomfort have been the most common withdrawal symptoms reported with onset being within one day of the last dose of caffeine, peaking within two days, and lasting up to one week or more while tolerance to caffeine's sleep disrupting qualities, cardiovascular effects, catecholamine release, and mood effects have been found to develop quickly (Dreisbach & Pfeiffer, 1943; Gilliland & Bullock, 1984; Goldstein, Kaizer, & Whitby, 1969; Greden, 1974; Greden, Victor, Fontaine, & Lubetsky, 1980; Griffiths, Bigelow, & Liebson, 1986; Griffiths & Woodson, 1988; Robertson & Curatolo, 1984). These withdrawal effects have even been demonstrated when the level of caffeine intake has been low (approximately equal to one cup of coffee per day) (Griffiths et al., 1990).

That caffeine may have addictive qualities does not by itself mean that the drug will be abused. Having reinforcing properties is generally considered necessary for a drug to be deliberately misused whereas having the capacity to do harm to the individual and/or society while having the tendency to be misused have been noted as being key components for a drug to be viewed as one of abuse (Griffiths, Lamb, Ator, Roache, & Brady, 1985). Evidence tends to show that

caffeine has weak abuse potential because only modest reinforcing properties and adverse effects have been documented (Griffiths & Woodson, 1988; Stern, Chait & Johanson, 1989). However, interest in caffeine as a possible risk factor for cardiovascular disease has been increasing and if current trends continue, caffeine may be viewed by society as an abusable drug in the future.

Central nervous system effects of caffeine

CNS effects of caffeine include stimulation of the cerebral cortex at low doses (50 - 200mg) and of medullary centers at higher doses (over 500mg). Fatal doses (reported to be over 5g.) are rarely encountered in regular use (Gilbert, 1976; Peters, 1974). Depending on dose and level of normal use, caffeine-induced CNS stimulation may result in the appearance of clearer flow of ideas, nervousness, insomnia, tremors, either positively or negatively affect psychomotor coordination or at higher doses nausea, vomiting, and convulsions (Brezinova, 1974; Curatolo & Robertson, 1983; Levy & Zylber-Katz, 1983; Rall, 1985). While these effects seem intuitively obvious from the description of caffeine as a "stimulant," behavioral improvements such as quicker reaction-times may only be appreciably noticeable when fatigue or other similar detriments are involved (Dews, 1984; Regina, Smith, Keiper, & McKelvey, 1974; Swift & Tiplady, 1988). It has also been found that caffeine intake increases work capacity and work load acceptability (Foltz, Ivy, Barborka,

1942; Foltz, Schiffrin, & Ivy, 1943). Systematic studies have not been conducted comparing fatigued and freshly-rested individuals for the effects of caffeine on performance and work tolerance, therefore it is not clear whether caffeine has only restorative effects or if it also can improve performance above baseline levels.

Recent focus on the mechanism behind caffeine's central stimulatory activity has been on blocking of the actions of adenosine (Boulenger, Salem, Marangos, & Uhde, 1987; Daly, Bruns, & Snyder, 1981; Dews, Grice, Neims, & Wurtman, 1984). The widespread effects of adenosine, and the variability of responsiveness to caffeine that is exhibited, make this a useful explanation for many of the different effects for caffeine that have been observed. The effects of adenosine tend to be opposite to those of caffeine with adenosine having sedative and anti-convulsant effects (Haulica, Ababei, Branisteanu, & Topoliceanu, 1973; Maitre, Cieslielski, Lehmann, Kempf, & Mandel, 1974; Marley & Nistico, 1972; Weiner & Olson, 1977). Additional evidence that blockade of adenosine receptors is the source of at least some of caffeine's effects stems from studies of binding affinity and effects of different methylxanthines with positive correlations resulting (Snyder, Bruns, & Daly, 1981).

In sum, caffeine has many CNS effects leading to a variety of mood and behavioral changes, many of which may be mediated by its blockade of adenosine receptors. Caffeine's putative effects are often subtle and subjective in nature

making them difficult to study and quantify and may only result in appreciable changes when consumed by an individual who is fatigued or countering caffeine withdrawal. However, as will be outlined in the section on caffeine and coping, depending on dosage and circumstances, caffeine can clearly be seen as having properties that could be beneficial in coping with stress.

Mood effects of caffeine

Mood effects attributed to caffeine use tend to be more positive in heavy users than in light users (Bradley & Petree, 1990; Goldstein & Kaizer, 1969; Goldstein, Kaizer, & Whitby, 1969; Graham, 1988; Page, 1987). For example, college students, split into groups based on usual caffeine consumption, were asked to rate how they perceive the effects of caffeinated beverages (Page, 1987). Those who regularly drank caffeinated beverages were more likely to perceive them as tasting good and being refreshing while giving people more energy and facilitating relaxation. This was in contrast with those who rarely drank caffeinated beverages perceiving them as more likely to make people irritable, nervous, and jittery and were more likely to believe that a number of negative health outcomes would result from drinking them. While it is not surprising to find that those that regularly drink caffeinated beverages perceive them in a more positive way than do those that rarely consume them, these studies do show the types of positive expectations regular caffeine drinkers

have.

In one series of studies, self-reported expectations of caffeine's effects were measured and then confirmed with a subsequent experimental study on a subsample of the original 239 subjects (Goldstein & Kaizer, 1969; Goldstein, Kaizer & Whitby, 1969). Regular coffee drinkers reported that caffeine made them feel more alert, content, and less irritable, while non-drinkers indicated that it made them feel jittery, nervous, and upset their stomach (Goldstein & Kaizer, 1969). Eighteen non-coffee drinkers and 38 heavy coffee drinkers (five or more cups of coffee per day) from this sample then participated in a nine-day study in which packets of coffee were supplied by the experimenters. The packets, containing decaffeinated coffee with either 0 mg, 150 mg, or 300 mg caffeine added, were to be consumed according to a schedule allotting three days for each caffeine level (Goldstein, Kaizer, & Whitby, 1969). Subject were instructed to abstain from caffeine after supper each day and consume the designated packet after breakfast. Decaffeinated coffee alone resulted in increased complaints of sleepiness and dysphoric feelings such as irritability among heavy coffee drinking subjects but had few effects on abstainers. The addition of 150 or 300 mg of caffeine, however, made abstainers' moods more negative, increasing reports of jitteriness, nervousness, and stomach upset. Heavy coffee drinkers reported positive affect, increased alertness, and decreased irritability when they had consumed caffeinated coffee. Similar reports of dysphoria

when caffeine deprived and reports of positive feelings when caffeine has been ingested by heavy coffee drinkers has been found in other experimental settings (Ratliff-Crain, O'Keeffe, & Baum, 1989).

In general, these studies indicate that regular, especially heavy, users of caffeine feel better emotionally and physically when caffeine has been consumed while those that rarely drink it report more negative effects. Contrary to these findings are studies on caffeine and anxiety. Positive correlations have been found between levels of caffeine consumption and anxiety (Greden, 1974). Caffeine-induced anxiety, referred to as "caffeinism," is similar in symptoms to other anxiety disorders and is generally associated with consumption of caffeine approximating at least 4 to 7 cups of coffee per day (American Psychiatric Association, 1987; James & Stirling, 1983; Greden, 1974; Greden, Fontaine, Lubetsky, & Chamberlin, 1978; Shisslak et al., 1985; Winstead, 1976). These symptoms include nervousness, irritability, tremulousness, muscle twitches, insomnia, palpitations, flushing, cardiac arrhythmias, diuresis, and gastrointestinal disturbances (Boulenger & Uhde, 1982; Greden, 1974).

Given the positive effects reported after caffeine consumption by heavy consumers (e.g., Goldstein, Kaizer & Whitby, 1969), it seems paradoxical that heavy caffeine use is correlated with increases in anxiety. Individual differences in sensitivity to the effects of caffeine and in

the reasons for its use could account for these apparently contradictory findings. Additionally, there exists the possibility of co-existence of positive effects and anxiogenic effects within the same individual. Anxiogenic effects may not be readily noticed or attributed to caffeine consumed or may be reinterpreted by heavy coffee drinkers drinking coffee for the other positive effects. The role of caffeine in the development of anxiety has not been studied in random samples of all users and the extent to which it acts as a contributing cause is unclear. Because of the correlational nature and the use of psychiatric populations in studies of caffeinism, causality cannot be easily determined leaving open the possibility that anxious people or people under stress may drink coffee in greater amounts than others. This may lead to a complicated process where caffeine may indeed exacerbate feelings of anxiety leading to a cycle of anxiety and caffeine consumption that could be difficult to break.

Health effects of caffeine

Caffeine has been studied for its possible role in the development of several diseases including breast, bladder, and pancreatic cancers; peptic ulcers; birth defects; and cardiovascular disease (Cole, 1971; Fraumeni, Scotto, & Dunham, 1971; Gilliland & Bullock, 1984; Grice, 1984; Leviton, 1984; Rall, 1985; Wethersbee, Olsen & Lodge, 1977). For most of these, it is difficult to separate the influence of caffeine itself from other components in caffeinated beverages

[for example, coffee contains hundreds of chemical compounds that may have effects independent of caffeine (Robertson & Curatolo, 1984)] and from associated lifestyle variables, such as cigarette smoking, that may have deleterious effects of their own. However, because of the stimulant effects of caffeine on the cardiovascular system, cardiovascular disease continues to receive the most attention.

Cardiovascular effects of caffeine. Caffeine has effects on the circulatory system including decreased peripheral resistance, cerebral vasoconstriction, increases in arterial blood pressure, and cardiac stimulation resulting in greater contractile force and increased heart rate, although this latter effect is often countered by concurrent vagal stimulation (Rall, 1985). The complex and often opposing actions of caffeine on the cardiovascular system stem from direct stimulation as well as indirect mechanisms mediated by catecholamines and possibly the renin-angiotensin system. Ingestion of 250mg of caffeine (two to 2.5 times that found in a typical cup of coffee) has been found to result in doubling of epinephrine levels and 50% increases in norepinephrine levels (Robertson et al., 1978).

Most studies investigating circulatory effects of caffeine have been studies of acute dosages of caffeine on either caffeine-abstinent subjects or subjects who have been required by experimental protocol to abstain from caffeinated beverages for anywhere from 24 hours to three weeks (cf., Conrad, Blanchard, & Trang, 1982; Robertson et al., 1978 &

1981; Smits et al., 1985; Zahn & Rapoport, 1987). These studies have reported increases in blood pressure of approximately 5-10%, but reports of tolerance to caffeine's hemodynamic effects have lead to estimates that chronic caffeine consumption may only lead to a 2.5% increase in the general population (Robertson, 1985). One important aspect of caffeine consumption that is ignored in these controlled laboratory studies is self-regulation. Naturalistic consumption follows a pattern of greatest consumption early in the day that tapers off to abstinence by the end of the day and starts anew the next day, a pattern very different from the carefully timed doses provided in laboratory studies (Gilbert, 1984). This pattern of caffeine consumption may then result in greater increases in blood pressure during certain times of the day, mostly those that overlap work and other stressful times of the day, and smaller increases during others.

Caffeine was found to affect cardiovascular responses in a natural work setting in one recent study (France & Ditto, 1989). Telemarketing employees participated on two consecutive days during work time and blood pressure and heart rate responses were measured with and without ingesting 250 mg of caffeine in a double-blind, counterbalanced test. The work resulted in increases from rest in systolic and diastolic blood pressure and heart rate while caffeine only significantly increased systolic blood pressure in this sample. Change in systolic blood pressure from rest to work

was also greater when caffeine had been ingested, indicating that systolic responses were accentuated with caffeine. Only a 12-hour caffeine abstinence period was used prior to testing and regular caffeine consumers were included in the study, indicating that normal patterns of use could still lead to increased cardiovascular responsivity in natural work settings. More thorough epidemiological study with ambulatory monitoring of blood pressure during the day will be needed to determine the actual extent of blood pressure increases in relation to self-dosed caffeine consumption.

Caffeine and cardiovascular disease risk. There is considerable debate regarding caffeine's contribution as a risk factor for cardiovascular disease. Whereas some studies report positive correlations between caffeine use and cardiovascular disease (Boston Collaborative Drug Surveillance Program, 1972; Jick et al., 1973; Klatsky, Friedmand & Armstrong, 1990; LaCroix, Mead, Liang, Thomas, & Pearson, 1986), others have reported no relationship (Bertrand, Pomper, Hilman, Duffy, & Micheli, 1978; Dawber, Kannel, & Gordon, 1974; Grobbee et al., 1990; Hennekens, Drolette, Jesse, Davies, & Hutchison, 1976; Klatsky, Friedman, & Sieglaub, 1973). These studies have varied widely in design, making either dismissal or acceptance of caffeine as a risk factor premature. Major criticisms of these studies include the use of retrospective measurements of caffeine use, relating incidence of disease to a single measurement of caffeine consumption taken many years previously, and the number or

type of other known risk factors accounted for in the analysis.

A recent study by LaCroix et al., (1986), using a longitudinal design with multiple caffeine measurement points and controlling for other risk factors, demonstrated a dose-dependent relationship between coffee consumption and coronary heart disease. Subjects who were drinking five or more cups of coffee per day were found to have an estimated relative risk of heart disease of 2.49 times that of abstainers when most recent levels of coffee consumption were compared. However, relative risk diminished as time between coffee use measurement and coronary event increased, demonstrating that single measurements of coffee consumption may not be as accurate at relating consumption to risk for cardiovascular disease at a later point as a measure made more proximally to the event.

Yet another longitudinal study, also using multiple measurements in a cohort of 45,589 men, found no relationship between caffeinated coffee use and cardiovascular disease (Grobbee et al., 1990). Interestingly, decaffeinated coffee use was associated with a moderate increase in risk. Both of these prospective studies controlled for potential risk factors other than coffee use, such as smoking, serum cholesterol levels, and hypertensive status at the beginning of the study. Other factors that were not measured were life stress and work loads which may have independently figured as risk factors for cardiovascular disease and for coffee

consumption. Heavier caffeine use has been associated with dietary and lifestyle patterns that have been identified as cardiovascular risk factors including lack of exercise, use of other drugs such as nicotine and alcohol, and Type-A behavior (Gilliland & Bullock, 1984; Hicks, Kilcourse, & Sinnott, 1983; Jacobsen & Thelle, 1987; Puccio, McPhillips, Barrett-Connor & Ganiats, 1990). Further study of why caffeine is consumed, the circumstances under which it is consumed, and of other potentially high-risk behaviors involved may help in determining how caffeine may be related with cardiovascular disease. Study of caffeine use during stress may provide some clues about one set of circumstances that may accentuate the risk potential of caffeine.

Stress and Caffeine

The mechanisms by which stress may affect health have implications for studies on caffeine. First, caffeine has physiological effects similar to the stress response and, second, its use may be affected by stress. However, studies of stress and caffeine use have been pursued only recently, generally focusing on the physiological effects of the two combined, working on the assumption that stress and caffeine consumption co-occur. Available evidence indicates that the two combined result in greater cardiovascular reactivity than either alone.

Caffeine and reactivity

As was described previously, caffeine results in sympathetic activation when ingested with the associated increases in blood pressure, but with variable effects on heart rate. The similarity of these effects to the stress response has prompted research examining the degree to which these effects overlap, add to one another, or interact to add to risk for cardiovascular disorders by affecting reactivity to stress. Henry and Stephens (1980) have found evidence for this role for caffeine as an intensifier for stress effects on plasma renin, corticosterone, and blood pressure levels as well as adrenal weight and mortality in mice. Following these results, studies of humans have generally found cardiovascular responses to caffeine in combination with laboratory challenges to be additive in light, moderate and heavy caffeine consumers (Greenberg & Shapiro, 1987; Greenstadt, Yang, & Shapiro, 1988; Lane & Williams, 1985; Lane & Williams, 1987; Myers et al., 1989; Ratliff-Crain, O'Keeffe, & Baum, 1989; Strickland, Myers & Lahey, 1989). Additionally, caffeine has been found to increase resting norepinephrine and stress-related epinephrine, norepinephrine, and cortisol responses in both habitual and light coffee drinkers (Lane et al., 1990).

Initial studies demonstrated that blood pressure increases from caffeine ingestion during rest added to blood pressure responses made during a challenging task such as mental arithmetic in subjects that normally consume less than

the equivalent of three cups of coffee per day (Lane & Williams, 1985; Lane & Williams, 1987). These subjects were caffeine deprived for at least 24 hours prior to the study and were given a drink containing the caffeine equivalent of 2 - 2.5 cups of coffee (250 mg). However, based on epidemiologic data, these subjects would not represent subjects at greatest risk for heart disease since they were not heavy coffee drinkers (cf., LaCroix et al., 1986). Additionally, evidence that complete tolerance develops to the effects of caffeine and that hemodynamic effects of caffeine are inversely related to current plasma levels of caffeine, made it necessary to evaluate heavier caffeine users both when caffeine deprived and when not deprived to determine if (1) caffeine continues to have hemodynamic effects in a more at-risk population and (2) these effects would be found under normal consumption levels and patterns.

To study these two questions, "heavy" coffee drinkers, those that consume at least four cups of coffee per day, participated in a study of caffeine and reactivity, once deprived of their normal morning caffeine and a second time after no deprivation (Ratliff-Crain, O'Keeffe, & Baum, 1989). These subjects then consumed in the laboratory either caffeinated coffee (approximately 130 mg caffeine), decaffeinated coffee, or a non-caffeinated herbal tea control beverage. Comparisons of deprived and non-deprived sessions demonstrated that heavy caffeine users continued to show increased resting levels of blood pressure after consuming

their normal levels of caffeine and that these increased blood pressure levels added to blood pressure changes made during challenge and that these patterns of effects were accentuated when caffeine was consumed during the session. Whereas this study does not show that tolerance does not develop to the hemodynamic effects of caffeine, it did show that increases in blood pressure persist in heavy users under normal use patterns.

Similar findings have been reported for caffeine consumed in combination with naturally occurring stressors (France & Ditto, 1989; Pincomb et al., 1987). Blood pressure, cortisol, and cholesterol reactions of medical students taking exams were increased by ingestion of 250 mg caffeine when compared with placebo (Pincomb et al., 1987). Cobb (1974) compared unemployed factory workers consuming caffeine with those that were not. Unemployment was associated with experiencing anxiety and distress at home while awaiting reemployment. Caffeine drinkers under these circumstances showed significantly greater norepinephrine secretion than non-drinkers. Interestingly, differences between caffeine drinkers and non-drinkers disappeared after reemployment.

These studies indicate that caffeine use during stress may exacerbate the harmful effects of stress itself. However, generalizations to situations outside of the laboratory environment need to be made with caution. The France and Ditto, (1989), study of telemarketers oulined earlier investigated caffeine's effects in a natural work setting, but

the caffeine dosages were chosen by the experimenters. Only one study (Cobb, 1974) has looked at the combined effects of stress and caffeine by evaluating a natural stressor with self-dosed caffeine levels. All other studies have given caffeine in pre-determined amounts and within a time frame designated by the experimenter. While this helps in the delineation of the pharmacological effects of caffeine when stress is present, these studies may not reflect actual behavior. Findings that caffeine and stress result in greater sympathetic responding and cardiovascular reactivity are important in terms of caffeine as an additional risk factor only if it is consumed during stress.

Stress and caffeine consumption

There is little information available on coffee consumption patterns in the general population (Gilbert, 1984; International Coffee Organization, 1982, 1989; Masterson, 1983). Survey data collected in the United States yearly since 1950 by the International Coffee Organization (ICO) has shown an overall decline in coffee use of over 40% from the highest average of 3.12 cups of coffee/person/day in 1962 to 1.75 cups/person/day in 1989. This decline in use was evident at all time periods of the day and consumption locations except during work, which was associated with an increase. Most coffee is still consumed at home (70%), however coffee consumed at work now accounts for 19% of the total, up from 8% of the total in 1962. Figured per person, coffee consumed

at work increased in amount by 31% since 1962. While this data cannot be used to determine why coffee is consumed, it does show that coffee is consumed at a time period when stress would be likely, at work, and that consumption is increasing during that time.

One study that has investigated the use of caffeine in response to stress was conducted by Conway, Vickers, Ward and Rahe, (1981). These investigators studied U.S. Navy company commanders over periods of systematic variations in their work-related stress levels and found significant positive correlations between self-reported stress and coffee consumption. Measurements of stress, coffee, cigarette, and alcohol consumption were obtained during two 46-day training periods and during two relatively non-stressful periods between training cycles. The training periods were times where the commanders needed to disseminate a large amount of information during a short, rigorously maintained schedule and were rated as being stressful. Clear increases in coffee and cigarette consumption were found during the two training cycles while decreases were found during non-stressed periods. While showing a temporal relationship, this study did not measure reasons why coffee intake changed. Without that information it falls short of being able to explain whether stress caused increases in coffee consumption. Further information about the use of caffeine in conjunction with stress is clearly needed.

Caffeine is linked to stress in a number of ways.

There are commonalities in both their physiological and psychological effects and caffeine may exacerbate anxiety states in at least some populations. Individual differences in responses to caffeine and reports of negative mood effects make speculations about the utility of its use during stress more complicated. Yet there is some evidence that caffeine use may increase during stress (Conway et al., 1981). Given these relationships, experimental demonstration that caffeine use changes during stress is the next logical step. By viewing caffeine intake as a possible coping response, reasons behind changes in use during stress can be determined as well. The following section will present arguments supporting the possibility that caffeine could be used for both problem and emotion focused purposes in regular users.

Coffee use as a coping strategy

In contrast to general conceptions of stress and substance use, where drugs are usually described in terms of their emotion-regulating properties, it is feasible to view coffee consumption in terms of problem-focused coping. The stimulating properties of caffeine are useful in that they may facilitate coping with specific demands. Caffeine has been associated with greater alertness, increased capacity for sustained intellectual effort, and clearer flow of thought (Greden, 1974), all of which would be useful in the manipulation of demanding situations. Low doses of caffeine have been shown to improve performance on both simple (e.g.,

math, coding) and complex (e.g., typing, driving) tasks (Gilliland & Bullock, 1984; Hollingsworth, 1912; Regina, Smith, Keiper, & McKelvey, 1974). However, these effects are generally only reported when subjects are fatigued, and otherwise caffeine may only bring caffeine-deprived subjects up to a level of subjective well-being comparable to non-caffeine drinkers (Gilliland & Bullock, 1984; O'Keeffe, 1991). Therefore, caffeine may be actively sought as a problem-focused coping strategy for certain types of stressors such as increased work load or imminent deadlines among those already accustomed to caffeine's effects. However, it is not clear whether caffeine would be ingested prophylactically or only in response to increased fatigue. In other words, whether someone would consume more coffee in preparation for a demanding day at work or if they would only consume more as the day began to have a fatiguing effect is not known. Additionally, it is not clear whether caffeine intake would increase only because of increased productivity demands or if intake may change in response to other types and/or aspects of stress as well such as general discomfort or anxiety.

Use of caffeine in non-performance related stressors may reflect other more emotion-focused reasons for its use. Evidence that caffeine can result in more positive mood during or after stress has come from several studies that have reported better subjective responses to stress or greater tolerance for work loads among habitual caffeine users when caffeine has been consumed (Foltz, Schiffrin, & Ivy, 1943;

Hauty & Payne, 1955; O'Keeffe, 1991; Payne & Hauty, 1954, 1955; Ratliff-Crain, O'Keeffe, & Baum, 1989). The sources of these more positive responses to stress are unclear. In studies where comparisons have been made with subjects that have been caffeine deprived, negative feelings associated with withdrawal may account for differences. Even the deprivation that occurs within normal consumption patterns, such as the absence of caffeine during sleep, can lead to increases of negative feelings including irritability, lethargy, and headaches (Goldstein, Kaizer, & Whitby, 1969; Griffiths et al., 1990; Ratliff-Crain, O'Keeffe, & Baum, 1989). Therefore, the differences between deprived subjects and those that have been given a dose of caffeine may be more from the negative effects associated with deprivation than any positive effects of drinking coffee other than from relief from deprivation (cf., O'Keeffe, 1991).

Stress may also aggravate withdrawal symptoms and caffeine would be sought as a way to counter these negative feelings rather than to eradicate the stressor. Similarly, negative feelings that accompany stress may be misinterpreted as being symptoms of withdrawal also leading to increases in caffeine intake (Grunberg & Baum, 1985). For example, when not deprived of caffeine, subjects who received herbal tea when compared to those that received coffee prior to an experimental challenge reported significantly greater desire for coffee following the task although levels of desire prior to the task were similar (Ratliff-Crain, O'Keeffe, & Baum,

1989). This was the case whether the coffee was caffeinated or not, indicating that this desire for coffee was not strictly a pharmacological phenomenon. However, the reasons for increased desire for coffee were not measured in this study leaving open the possibility that subjects were desiring coffee for other reasons.

Further evidence that caffeine may be sought out for its effects by habitual drinkers, rather than strictly for relief from withdrawal, has recently been reported (Bradley & Petree, 1990; Graham, 1988). Relief from negative feelings, such as feeling depressed, upset, under pressure or tense were found in these studies to figure prominently into predictions of level of caffeine consumption. While stimulant reasons and reasons based on characteristics of the beverage (e.g., taste) also figured into patterns of consumption, only relief and beverage reasons figured significantly in predicting both dependence and level of consumption. If caffeine consumption and dependence is associated with relief from feelings of tension or depression, this would indicate that emotion-focused reasons for caffeine consumption exist as well as problem-focused reasons.

Positive emotional effects may also be the result of perceived changes in ability to handle stressors rather than as a product of coffee consumption per se. Given a situation that is perceived as taxing but unchangeable, another behavior may be sought out to bolster the belief that the situation was controllable. If coffee is perceived as an energizing entity,

drinking it may help promote the belief that something has been done to deal with the situation. Believing one has control can reduce the aversiveness of stressors, making actions that result in a perceived gain in control reinforcing (Baum, Fleming, & Singer, 1983). The implication is that coffee use may result in decreases in perceived stress because of the belief in its ability to facilitate performance (a more problem-centered use) and this would reinforce the use of coffee during stress.

Why caffeine is desired when feeling upset or tense is not entirely clear, however, because the stimulant effects of caffeine could be thought to aggravate those symptoms. It also would make sense that caffeine consumption would decrease in response to stress because of its stimulating properties and possible relationship with increased anxiety, especially among heavier caffeine users prone to caffeinism. However, self-report of expected feelings associated with caffeine intake by habitual or heavy coffee drinkers tend to be positive and would be an asset in times of stress whereas the negative feelings reported by more occasional drinkers would not. A first important step is to establish whether caffeine is used in response to stress. By simultaneously studying what type of stress elicits changes in caffeine consumption, there may be some clue as to why it is used as well, either for problem or emotion-focused purposes or some combination.

In sum, the relationships noted between moods associated with stress and caffeine consumption imply that

increases in caffeine intake among usual caffeine consumers during stress is a feasible outcome. It may be consumed more during stress not just because of the need to perform for a greater period of time or to fight off fatigue, but also in response to other negative feelings as well-- feelings that would not normally be expected to be alleviated via caffeine's stimulant effects. This means that caffeine may not be consumed solely for dealing with performance demands but in response to other aspects of stress as well and possibly as way to gain control over stressful situations. If this is the case, it would be expected that increased demands that were associated with threat would lead to greater caffeine intake than if no threat was involved.

Research objectives and overview

The major purpose of this study was to determine (1) if caffeine consumption changes during a laboratory stressor and (2) if problem-focused reasons associated with increased performance demands represent the sole reason for caffeine use during stress or if emotion-focused reasons play a role as well. Additionally, this study assessed relationships between perceptions of control and coping behaviors. For the experimental manipulation, a 2 X 2 factorial design was used, high and low performance demands were crossed by absence of noise or exposure to uncontrollable noise, in a sample of moderate to heavy coffee drinkers (at least three cups of coffee per day). Given previously reported differences in

patterns of coffee consumption among those with positive versus negative expectations of effects (e.g., Bradley & Petree, 1990; Graham, 1988), the possibility that different patterns of consumption may be noted among individuals during stress needed to be anticipated. Therefore, by use of self-report, the study also evaluated the role that person-situation interactions may play in coffee drinking patterns and coping responses.

The amount of coffee consumed in contrast with non-caffeinated herbal tea in response to stress was monitored and individual differences in coffee drinking patterns and responses to the laboratory situation were used to further evaluate consumption under stress. Other beverages were not considered in this study as coffee represents the major way in which caffeine is consumed and coffee drinkers consume, on the average, more caffeine than non-coffee drinkers (Gilbert, 1984).

To avoid having an effect on how beverages were consumed in the laboratory, a cover story was employed to obscure the fact that the major interest was in coffee intake. The study was advertised as a study of stress and office work needing normal volunteers. Potential subjects were screened for this and "other studies" so information about normal coffee drinking could be assessed. It was explained that "we are interested in how different aspects of office work may affect worker happiness and productivity. For example, whether people get paid by a flat-rate salary or by the amount

of work performed or how often breaks are given all may affect worker performance."

The two major experimental manipulations were designed to affect how much performance demand subjects needed to deal with and level of uncontrollable stress. The purpose of these manipulations were to affect the balance between the need for emotion regulation and the need to deal with the problem directly through increased productivity. It was not possible to eliminate the emotional component of stress from the demand manipulation, therefore it was also necessary to evaluate the role of demand on coping and coffee drinking based on subjective reports of demand and emotional changes in response to the task and noise.

Intermittant, unpredictable noise was chosen as the uncontrollable noxious stimuli because of its ease of applicability to the office environment scenario and because of its successful use for this purpose in previous research (e.g., Glass & Singer, 1972). From the work of Glass and Singer (1972), it was anticipated that noise exposure would not affect task performance during the noise, but in order for subjects exposed to noise to compensate for that exposure continued effort at adaptation would be needed. The use of emotion-focused coping as part of the adaptive process was of primary importance in this study.

Performance demand was manipulated by either paying subjects based on the amount of work that was correctly completed or by making no demands on the amount of work

necessary. Half of the subjects were exposed to intermittent noise played over headphones. They were told that the noise was a necessary part of the study and that there was no way to stop it, thereby manipulating the amount of control subjects had over a noxious stimulus. The remaining subjects wore headphones, but no noise was played. The four resulting conditions were: Low Demand/ No Noise, High Demand/ No Noise, Low Demand/ Uncontrollable Noise, and High Demand/ Uncontrollable Noise.

Subjects worked alone on the task. Every fifteen minutes they were given a five-minute "coffee break" and were told to help themselves to the refreshments provided (coffee, herbal tea). Both beverages were available to all subjects at all times, not just during breaks, and the serving urns were clearly marked as containing "coffee" or "herbal tea." Amount of each beverage consumed during the entire session was recorded. The working period lasted a total of approximately one hour and 35 minutes, allowing for four breaks.

Hypotheses

The role that caffeine may play in the development of cardiovascular or other disorders remains controversial. Recent studies showing caffeine's additive effects on physiological reactivity associated with stress or challenge indicate that if caffeine is consumed during stress, the combined effects may be more detrimental than either alone. While reasons for caffeine use during stress can be

hypothesized (e.g., for increased alertness or emotional regulation), evidence regarding self-dosing of caffeinated beverages during stress is lacking.

The present study was designed to not only test whether coffee consumption changes as a function of stress, but also to explore the possible coping purposes that a caffeinated beverage may serve. Because controllability of a stressor has been hypothesized as affecting the type of coping strategy used-- problem-focused for controllable stress; emotion-focused for uncontrollable stress (Folkman & Lazarus, 1980)-- exposure or absence of an uncontrollable stressor in combination with high or low levels of controllable demand was used as a way to manipulate preferred coping strategies by subjects. It was expected that both styles of coping would be used by a majority of subjects, but that the manipulations of demand and noise exposure should affect the balance of the use of the two styles of coping. Information from questionnaires and amounts of coffee consumed were then used to determine the possible utility that coffee may have had as either a substance used for emotion regulation or problem oriented purposes or both. It was predicted that:

1. High demand with uncontrollable noise would result in the greatest amount of reported stress and low demand without noise would result in the lowest reported stress levels. The other two conditions, high demand without noise and low demand with uncontrollable noise, were expected to result in greater reported

stress than the low demand/ no noise condition but lower than the high demand/ uncontrollable noise condition. Cortisol levels were expected to parallel self-reported stress levels. Heart rate levels were hypothesized to be higher among subjects expected to perform under high demand conditions but not expected between noise conditions because of adaptation to the stimuli among high noise subjects.

2. Given the relationship between controllability and coping strategies, high work demand was expected to lead to greater reporting of problem-focused strategies in comparison with low work demand. Similarly, a greater proportion of problem- to emotion-focused strategies were expected to be found in the high work demand groups. Likewise, uncontrollable noise was hypothesized to lead to an increase in emotion-focused strategies in comparison with those not exposed to noise and a greater emotion- to problem-focused strategy ratio. Therefore, high demand with uncontrollable noise was predicted to lead to the greatest number of coping strategies used (total) and low demand without noise, the least. Self report of mood effects and perceived demand associated with the situation were used to evaluate the effectiveness of the manipulation and to clarify the relationships among these constructs and coping strategies.

3. Consumption of coffee was expected to parallel stress levels with high demand/ uncontrollable noise subjects consuming the most and low demand/ no noise subjects the least. More coffee than non-caffeinated herbal tea was hypothesized to be consumed in each condition. Increased levels of coffee consumption were expected to be the result of coffee being used for both emotion and problem-focused purposes. Self report of mood and perceived demand associated with the task were used to help clarify the relationships among these and coffee consumption.

Methods

Subjects

Sixty-four (32 men, 32 women) completed participation in the study. The data from one male subject was not included in analyses because of excessive average coffee consumption relative to the rest of the sample (he generally consumed an average of 20 cups of coffee/day, 2.55 standard deviations above the next highest consumption level of 12 cups/day). The resulting sample of 31 men and 32 women ranged in age from 19 to 68 years of age (mean age = 40.41, SD = 13.2). Sessions were conducted in four locations that ranged from urban to rural: Uniformed Services University of the Health Sciences, Bethesda, MD (N = 9), University of Minnesota, Minneapolis (N = 5), University of Minnesota, Morris (N = 34), and the Willmar Community College, Willmar, MN, (N = 15).

Recruitment

Initial advertisements read, "We are currently seeking paid volunteers to participate in one of several studies being conducted at the Medical Psychology Department of the Uniformed Services University of the Health Sciences, including a study of stress and office work which needs normal volunteers." Because of inadequate response by eligible coffee drinkers, a second recruitment approach was taken. New advertisements stated that we were seeking non-smoking volunteers who drank at least three cups of coffee per day to

participate in a study of coffee consumption and stress. When potential subjects called, they were told about a bogus study that was described as being "part of a series of studies on life stress and health" that supposedly evaluated the effects of caffeine on being able to perform a challenging task (e.g., discerning between two similar images flashed on a screen). They were then screened for health status and current drug and alcohol use as well as current coffee and caffeine consumption (see Subject Screening Form, Appendix B). If they matched the criteria for the present study, they were informed that their alcohol consumption was too high (or too low, if non-drinkers) for the present study, but that they fit our criteria for an alternate study that was part of the same program on life stress and health.

If potential subjects were still interested, they were then told: "We are interested in how different aspects of office work may affect worker happiness and productivity. For example, whether people get paid by a flat-rate salary or by the amount of work performed or how often breaks are given all may affect worker performance." Subjects were also told that they would be paid "up to" $25 for their participation. Sessions began between 6:00 a.m. and 12:00 p.m., to restrict time-of-day effects on coffee consumption, and lasted approximately three hours.

Design

Performance demand (high or low) was crossed with presentation of high or low (ambient) uncontrollable noise in a 2 X 2 factorial design. Subjects were assigned to each condition within blocks of time (6:00 a.m. - 9:30 a.m.; 9:30 a.m. - 11:00 a.m.; 11:00 a.m. - 1:00 p.m.). Within each time block, numbers of subjects were kept even across all conditions. Numbers of male and female subjects also were evenly distributed across conditions. The coffee used was brewed decaffeinated coffee made to manufacturer's specifications which yielded less than 4mg of caffeine per 8oz cup. Decaffeinated coffee was used to avoid confounding effects associated with the sympathomimetic effects of caffeine. Brewed decaffeinated coffee was chosen for optimal flavor. Subjects were simply informed that the beverage was "coffee" and a can of regular (caffeinated) coffee was clearly visible to emphasize the idea that it was caffeinated coffee. Coffee was served in a large, restaurant-style coffee urn. Lipton cinnamon-apple herbal tea, containing no caffeine, was used as the control beverage. One urn was labeled "coffee," the other "herbal tea." No caffeine restrictions were required prior to arrival at the laboratory, although coffee and caffeine intake prior to arrival at the laboratory was assessed.

Measures

Physiological measures

Heart rate levels were measured as part of the assessment of the effectiveness of the manipulation of demand and urinary cortisol levels as an index of stress. Heart rate was measured using a portable ear photoplethysmograph which both calculates heart rate in beats per minute based on inter-beat intervals and displays a light with each pulse wave. Heart rate was calculated by the experimenter over thirty-second periods from the light flashes that marked pulse waves. Three resting baseline heart rate measurements were calculated at two-minute intervals following a five minute rest period where subjects were asked to simply close their eyes and relax. The resting period and baseline measurement occurred prior to providing subjects with detailed instructions about the task. Heart rate was also measured during the first, second, fifth and last minute of each of the five fifteen-minute work-blocks.

Three urine samples were obtained for urinary cortisol measures. The first sample was of the first morning void that subjects brought into the laboratory. The second two voids were obtained at the laboratory with subjects voiding to empty their bladder upon arrival at the laboratory and again 30 minutes following the end of the final work-block. The first sample was treated as a resting baseline sample and the last as a sample affected by reactions to the experimental

situation. The first sample obtained at the laboratory was intended only as a way to empty the bladder and remove urine in which cortisol from prior experiences had built up and, therefore, was not assayed. All samples were preserved with sodium metabisulfite and kept refrigerated until aliquotted. Following the session, urine sample volumes were measured and a 10ml sample from each total sample was aliquotted and frozen at -30 degrees Centigrade until assayed later for cortisol levels using a competitive binding radioimmunoassay (Baxter Dade Clinical Assays, Cambridge, MA).

Self report measures

Questionnaires were given to assess mood, background information, and general need for control prior to the task; mood changes during the task; and mood, task/noise perceptions, strategies for coping with the task/noise, food and caffeine consumption that day, and usual caffeine use were assessed following the task. The mood and task/noise perceptions forms were each factor analyzed and only factors meeting appropriate internal reliability criteria were used for analyses. These two questionnaires provided separate information regarding emotional responses to the experimental manipulations and the appraisal of the situation, with the two forms providing convergent information about levels of stress experienced by subjects. Each of the questionnaires used in the study are described in more detail in this section.

Background. Basic demographic information was obtained at the beginning of the session so that group comparability could be assessed. Questions regarding personal information such as age, gender, education, and income were presented in multiple-choice format. Additionally, normal work habits were assessed in open ended questions so that types of work, such as bookkeeping, that might influence reactions to the task could be monitored. Questions pertaining to health status were asked during the phone screening.

Desire for control. Desire for control was measured using a scale devised by Burger and Cooper (1979) to help determine if this construct had bearing on the use of caffeine during stress. Questions were answered on seven-point Likert scales where ratings ranged from one ("The statement doesn't apply to me at all)" to seven ("The statement always applies to me.") There were 16 statements in all including, "I don't mind people scheduling my time," and "I enjoy making my own decisions." A single score reflecting need for control was calculated.

Mood. Mood, was measured by a modified Feelings and Moods questionnaire used previously in this laboratory (Ratliff-Crain, O'Keeffe & Baum, 1989). The questionnaire measures mood and physical feelings, both positive and negative, with items included that directly assess feelings often associated with caffeine use or deprivation. This instrument was given three times: baseline, during the third

rest period of the task, and at the end of the task. Responses to the baseline Feelings and Moods questionnaire were scored from 0 (not at all) to 4 (extremely) and the subsequent two forms given at the middle and end points of the task were scored from -2 (very much less than before) to +2 (very much more than before).

Coping. Coping behavior was measured using the Ways of Coping scale (Lazarus & Folkman, 1984) which assesses thoughts and actions taken to deal with a specific stressor and categorizes them into "problem-focused" and "emotion-focused" strategies. Subjects were asked to note how often they used the different thoughts and behaviors listed from 0 ("Never used") to 3 ("Regularly used") to deal with the office task and noise experienced during the laboratory session. This scale was used to determine if there was a preference for either type of coping and whether this preference predicted use of caffeine during stress.

Task/noise perceptions and manipulation checks. In order to ascertain the effectiveness of the demand and noise manipulations a ten-item questionnaire was provided that asked subjects to rate on a Likert scale from "not at all" to "extremely" how much effort they placed into the task, how upsetting the task and noise were, how successful they felt they were, how demanding the task was, and how bored they were by it. Additionally, this questionnaire included one item that asked how much control [they] felt [they] had over succeeding at the task and another regarding control over

stopping the noise.

An open-ended question was also provided that simply asked subjects to relate what they felt the purpose of the study was and encouraged them to provide any other comments. This form was then screened for comments that would have indicated suspicions about the task manipulations, noise controllability, or purpose of coffee containers. An interview after all data had been collected also served as an opportunity for suspicions to be voiced.

Because decaffeinated coffee was used, perceptions of the beverage's caffeine content were also requested. How the coffee's taste and caffeine content compared to subjects' normal coffee was assessed on a Likert scale anchored at "very different" and "exactly the same" for taste and "very much less" and "very much more" for caffeine content. These questions were imbedded in a questionnaire that asked more general questions about the laboratory environment in comparison to their normal work.

Caffeine use. The final two questionnaires completed by subjects asked questions regarding caffeine use on the day of the study (including estimates of coffee and tea consumed during the study) and general caffeine intake. The general caffeine use form included questions about style of use, length of use, symptoms related to caffeine addiction, and use of caffeine during stressful periods.

Beverage consumption

Beverages, coffee or herbal tea, were mixed or brewed immediately prior to each session. Beverages were made to manufacturers' specifications and all ingredients were carefully measured to keep flavor as consistent as possible between subjects. Beverages were served in self-serve, restaurant style coffee servers with a spigot to make it as easy as possible for subjects to fill their cups yet make it more difficult for them to keep track of the total amount consumed. Beverage remaining in the server after the session was measured and this volume was added to any beverage remaining in any cups used, the total then being subtracted from the original volume to determine the amount of beverage consumed.

Noise stimuli

The noise that was experienced by subjects was a recording of broadband noise used in previous studies on uncontrollable noise played over headphones (Glass & Singer, 1972). Subjects in the low (ambient) noise condition also wore headphones, but did not have any noise played. The headphones were of the foam wafer design, so both high and low noise subjects were able to hear noises from the surrounding room. The noise began at the start of the task and lasted approximately 20 to 40 seconds at a time. Noise was then followed by 45 to 120 seconds of silence followed by another burst of noise. The timing of the noise bursts and

the intervals in between were programmed on tape to keep noise densities consistent for subjects exposed to it. This repetition of silence and noise continued until the termination of the task, except during break periods when no noise was played. The noise was at a loud but not harmful level of approximately 90 to 95 dBA at the subjects' ears. Subjects presented with noise were given the impression that the noise was an integral part of the study and could not be stopped.

Task

The task was presented as being similar to one that could be encountered in a clerical office setting. The task itself was a two and one-half page form, similar to a tax form, that needed to be filled out for different clients with information provided. Each form required extensive calculation and did not take any subject less than twenty minutes to complete, therefore requiring more than one task period to complete each client. All subjects were told that they would be given periodic breaks during which they would be expected not to work on the task. (Task forms are included in Appendix C).

All subjects were told that they received $10 automatically for coming to the laboratory, but that they needed to earn the rest doing the task. Half of the subjects were then told that they would be paid $15 no matter how much work was performed while the other half were told that they

would receive $2.50 for each client's form that was successfully completed, up to $15 for six forms. This was done to manipulate low and high work demand with those subjects working at a per-piece basis being in a higher demand situation.

The effectiveness of the high demand situation for being stressful was piloted on five respondents to the original advertisement prior to conducting the study proper. Pilot subjects did not have any beverages available during the session and had their blood pressure monitored at five-minute intervals by an automatic blood pressure measuring device. Otherwise, pilot sessions were identical to the high and low demand sessions with low noise. Mood ratings by pilot subjects varied and task perceptions were comparable. However, high demand pilot subjects showed average increases in systolic blood pressure more than three times that exhibited by the low demand pilot subjects (9.0 mmHg average increase versus 2.6 mmHg for the low demand group). Additionally, blood pressure tended to increase throughout the session for the high demand subjects, but not the low demand. Based on these trends, the manipulation was deemed acceptable. These pre-tests on the task also showed that work demands greater than that stipulated for the high demand subjects was perceived as un-doable.

The four resulting conditions were given the following descriptions of the study:

LOW DEMAND/LOW NOISE group was told, "We are

interested in the ways that different modes of payment and break schedules affect worker performance and satisfaction. We would like you to work on these forms, working at whatever pace you are most comfortable. You will be paid a $15 salary for the time you put into the job and this will not be affected by how many of the forms you complete." Subjects were told that headphones must be worn to serve as a comparison for other portions of the study. No mention of noise was made.

LOW DEMAND/HIGH NOISE group was told, "We are interested in the ways that different modes of payment and break schedules affect worker performance and satisfaction. We would like you to work on these forms, working at whatever pace you are most comfortable. You will be paid a $15 salary for the time you put in to the job and this will not be affected by how many of the forms you complete." Before the task began, subjects were also told, "In order to make this experiment as similar as possible to real-life experiences, it was necessary to try and duplicate the types of distractions that may be encountered in real offices. In this case, we have chosen noise. Noise will be played over these headphones at a volume that you may find disturbing but not dangerous or painful. It is important for the purposes of the experiment that you leave the headphones in place."

HIGH DEMAND/LOW NOISE group was told, "We are interested in the ways that different modes of payment and break schedules affect worker performance and satisfaction. We would like you to work on these forms, working at whatever pace you are most comfortable. You will be paid $2.50 for each client's form that you successfully complete, up to $15 for six forms. Most subjects have found this to be difficult to do in the time allowed." Subjects were told that headphones must be worn to serve as a comparison for other portions of the study. No mention of noise was made. At the start of each work period, subjects were asked how they were "coming along" and were informed of how many work periods remained.

HIGH DEMAND/HIGH NOISE group was told, "We are interested in the ways that different modes of payment and break schedules affect worker performance and satisfaction. We would like you to work on these forms, working at whatever pace you are most comfortable. You will be paid $2.50 for each client's form that you successfully complete, up to $15 for six forms. Most subjects have found this to be difficult to do in the time allowed." Before the task began, subjects were also told, "In order to make this experiment as similar as possible to real-life experiences, it was necessary to try and duplicate the types of distractions that may be encountered in real offices. In this case, we have chosen noise. Noise will be played over these headphones at a volume

that you may find disturbing but not dangerous or painful. It is important for the purposes of the experiment that you leave the headphones in place." At the start of each work period, subjects were asked how they were "coming along" and were informed of how many work periods remained.

Procedures

At all locations, the study was conducted in a room that was arranged to look like an office. The experimenter was either separated from subjects either by a partition or by sitting at a desk facing away from where subjects worked. At all times, the experimenter was accessible to subjects, but did not appear to be monitoring subject behavior.

One week prior to the scheduled appointment, each subject was mailed a urine specimen container. Subjects were instructed to supply urine from their first void of the morning on the day they were scheduled to participate in the study. It was requested that samples be kept refrigerated. Upon arrival at the laboratory, the "office stress" purpose of the study was reiterated, without any details specific to assigned condition being given, and informed consent was obtained (see Appendix A). Following this, background, baseline mood, and Desire for Control questionnaires were given and subjects were then directed to the restroom where they provided the second urine sample which was then placed on ice upon returning. Subjects were then asked to relax and the initial three heart rate measures were obtained after five minutes of sitting quietly.

Following the baseline rest, instructions on how the

task was to be performed were given followed by instructions specific to the assigned condition. Availability of herbal tea and coffee was made at this time and was described as being available since participants were to be in the study "so early in the morning for such a long time." Any questions regarding these were answered, and then the experimenter moved to his own desk so the task could start. One minute into the task, heart rate was again measured, and again at the second and fifth minutes of the task. After fifteen minutes, the experimenter re-entered the room, measured heart rate, and asked that the subject take a five minute break and again mentioned the beverages that were available. Subjects were asked to keep conversations to a minimum to keep subjects from spending the break conversing with the experimenter. This 15 minute test/ 5 minute break sequence was repeated five times (total time being one-hour and 35 minutes). During the third break, the second feelings and moods form was given.

After the task was finished, the third mood form was given followed by the task impression instrument, and the Ways of Coping, task/beverage manipulation checks, and caffeine use questionnaires. Thirty minutes after the end of the task, the third urine sample was obtained and placed on ice. Finally, subjects were interviewed to assess how much they believed the manipulation and to inform them of the true purpose of the study. Because of the deception employed, they were then asked permission for the use of their data, and to initial a form stating if they agreed. All subjects agreed to the use

of their data. Subjects then paid a total of $25, regardless of amount of work performed or group assignment, and were then dismissed.

Data reduction

Scores from the second mood form (scaled from -2 to +2) were added to the appropriate item scores of the baseline form (scaled 0 to 4), and scores from the third form (scaled from -2 to + 2) were added to the combined previous item scores to provide an index of total perceived level of feeling for each item at that time. Scores for any one mood item could range from -4 to +8 for the final time period. Item scores from the three time periods were then factor analyzed using a principal component analysis with Varimax rotation and the resulting factor scores for each time period were used individually for further analyses.

Five factors were identified with eigenvalues greater than 4.0 and items with factor loadings of an absolute value of .30 or above during at least two of the three time periods were included in the factor. Results of the factor analysis are presented in Table 1a. Reliability testing of the factors yielded Chronbach's alphas ranging from .765 to .878. The five factors were interpreted as representing "Irritation," "Stress," "Lethargy/discomfort," "Helplessness," and "Contentedness/comfort," respectively.

Eight of the ten questions of the task/noise perception form were factor analyzed. The two questions

regarding control over stopping the noise and over succeeding at the task were not included in the factor analysis since they would be entered separately in multiple regression correlation (MRC) analyses. The factor analysis resulted in one factor with an eigenvalue of 2.70 that consisted of all of the remaining questions except the rating of noise loudness (see Table 1b for factor loadings of included variables). Larger scores on this factor indicated greater effort demanded by the task with less perceived success and being more upset by the task and noise.

Baseline heart rate was calculated as the average of the three measures obtained during the initial resting period. Repeated measures analyses were conducted using changes from baseline for the four measurements obtained during the five task periods. These were used to control for baseline effects and to track patterns of change over the fifteen minute task periods.

Cortisol concentrations, estimated in ng/ml from the radioimmunoassay, were multiplied by total ml of urine obtained from the corresponding voids to estimate total cortisol eliminated. This procedure was adopted to control for any possible dilution since urine output was significantly correlated with amount of coffee consumed during the laboratory session ($r = .37$, $p < .01$). Cortisol levels from pre-lab voids were entered as covariates in ANOVAs and previous to cortisol levels obtained from the final voids in MRCs to control for individual baseline variations.

Thoughts and behaviors on the Ways of Coping scale, (Lazarus & Folkman, 1984), were scored from 0 (not at all) to 3 (used often). Total scores were calculated by adding the ratings of use for each item associated with one or the other of the two major strategies of coping identified, problem-focused or emotion-focused. The ratio of emotion- to problem-focused usage was also calculated to reflect the preference of one style over another.

Summary of data analyses

The hypotheses in this study concerned (1) emotional and physiological responses to high and low levels of demand and exposure to uncontrollable noise as indicators of stress; (2) coping strategies employed in response to perceived controllability of stressors; and (3) coffee consumption in response to controllable and uncontrollable situations and whether patterns of consumption fit into the model of emotion- and problem-focused coping discussed by Lazarus and Folkman (1984). The data analyses were designed to test these hypotheses, accounting for possible demographic and other individual differences among subjects.

Demand and controllability factors

Physiological (heart rate, cortisol) and emotional responses (self-reported mood) were entered as dependent variables in separate repeated measures analyses of variance (ANOVA). High or low demand and presence or absence of noise were entered as independent variables. Additionally, since

perceptions of demand or control may be individually interpreted, the dependent variables were also analyzed with self-reports of task demand and task controllability entered as independent variables. Greenhouse-Geisser adjustments were used to account for spurious exaggeration of degrees of freedom caused by interrelatedness of measures obtained within close time frames. This approach has been suggested as being preferable to the multiple analysis of variance (MANOVA) approach to repeated measures as a way to prevent Type I error (Huberty & Morris, 1989). Unplanned comparisons of means from significant ANOVAs were tested for significance using the Tukey Honestly Significant Difference (Tukey HSD) test (Hays, 1981).

Coping strategies

Predictors of coping strategies were analyzed using MRC analyses (Cohen & Cohen, 1983). Independent variables were entered hierarchically as sets of related variables, with sets progressing from more basic, background information to variables that were more specifically hypothesized as being predictors of coping. The individual members of each set were entered into the appropriate set hierarchically. Each set of variables had to lead to a significant change in R^2 for any one member of the set to be tested for significance. Error degrees of freedom for tests of significance were calculated by including all of the variables in the set currently being tested in addition to all variables previously entered in the

equation. This method of analysis is an extension of the Fisher's protected t-test for MRC analyses described by Cohen and Cohen (1983, pp. 166-177).

ANOVAs and t-tests were conducted first to determine which variables (i.e., background, experimental manipulations, task perceptions and performance, physiological responses, etc.) may have significantly affected patterns of response. Additionally, variables directly related to hypotheses regarding coping (e.g., need for control, mood factors) were included in MRC analyses. The pre-selection of variables to be entered into the equations was conducted in order to narrow the analyses to relevant items to maintain analytical power.

The following order for entry of sets was used for analyses of coping strategies: demographic variables, need for control, general task perceptions, task success and effort employed, each of the five mood factors at baseline, and last, the coping variable not already figured into the equation (emotion-focused coping when problem-focused coping was the dependent variable and the converse when emotion-focused coping was the dependent variable). An identical analysis was conducted substituting mid-point mood factors for baseline moods as the fifth step in order to determine how emotional responses at the peak period of the task may have affected patterns of coping. A third identical analysis was conducted entering the amount of change in mood from baseline to mid-point as the fifth step in order to determine the effect of change in mood on coping. See Tables 10-12 for which

variables were entered for each test.

Coffee consumption

Coffee consumption in the laboratory was estimated in two ways. The first was simply the amount of coffee left in the urn at the end of the session. The second was an estimate of the proportion of usual daily coffee intake consumed while in the laboratory. This was calculated by subtracting the amount of coffee left in the urn at the end of the session from an estimated maximum end amount,[1] with this difference then divided by the self-reported usual daily intake (in ml). This proportion would be affected by the amount of coffee usually consumed, in that those who consume only three cups of coffee per day could consume 33% in the lab by drinking one cup whereas those normally drinking nine cups per day would need to drink three, so level of usual coffee consumption was still entered into the MRC analyses of this variable.

The approach to the MRC for analyses of coffee consumption was similar to that described for analyses of coping. In addition to the set of appropriate demographic variables, however, additional sets of background variables directly related to coffee use (i.e., usual total use, use of caffeine when under stress; caffeine consumption that day prior to study, and tea consumption at the lab) were added. The format for the subsequent sets of variables was otherwise identical to that described for coping variables, except that only mood factors with significant simple correlations with

consumption variables were used. Problem- and emotion-focused strategies were entered as predictors following the entry of mood factors. Similar to the coping analyses, separate analyses were conducted entering baseline, mid-point, or changes in mood factors into the equation. These were again repeated with the ratio of emotion- to problem-focused techniques entered in place of the separate coping factors. See Tables 13-14 for models used.

Individual differences in patterns of coffee intake in response to stress were further investigated by splitting data based on subjects' answers to the question, "When you are experiencing stress at home, school, or on the job (extra work, financial worries, arguments, etc.), how does the stress affect your use of caffeine (coffee, tea, etc.)?" The answers were coded from -2 ("my intake greatly decreases") to 2 ("my intake greatly increases"), with 0 representing "no change." Subjects who reported that their intake increased (N = 26) were compared to those who reported no change or decrease (N = 37). To test interactive effects of perceived stress with self-reported coffee use patterns on lab coffee consumption, self-report measures of mood and task interpretations were entered as independent variables along with designation from the stress/caffeine-use question in 2 X 2 analyses of variance. The self-report measures of mood and task perceptions had been dichotimized through use of median splits into high and low groups. The Tukey HSD was again used for unplanned comparisons of means of significant interactions.

Results

Comparability of experimental groups

No significant differences among the four experimental groups were found for the demographic variables of age, education, marital status, income, or employment status. Comparisons of different locations where study was conducted indicated no differences. Subjects assigned to high demand conditions reported having more family members living within 30 miles of them, averaging 10.5 family members, than did low demand subjects who reported an average of 4.3, $F(1,62) = 5.08$, $p < .05$. A noise by demand condition interaction was found for self-reported total coffee consumption per day, $F(1,62) = 7.62$, $p < .01$, however comparisons of means were not significant. Average daily coffee consumption for each group was, in 8oz cups per day: low demand/low noise (LD/LN) = 5.06, low demand/high noise (LD/HN) = 6.69, high demand/low noise (HD/LN) = 7.33, high demand/high noise (HD/HN) = 5.44. No other differences in usual coffee consumption were noted and the groups were comparable in amounts of coffee and caffeine consumed prior to arrival at the lab. No differences were found among groups for starting time of the sessions. The average starting time for the study was 8:40 a.m., with the average starting time for each group being between 8:04 and 8:51 a.m. and group assignment was evenly distributed at each of the experimental sites.

Manipulation checks

Caffeine content of coffee

Perceived caffeine content of the coffee, relative to coffee normally consumed, had been assessed on a seven-point scale with responses ranging from 1 ("very much less") to 7 ("very much more"). The mean of the responses was 4.2 (s.d. = 1.24), with the modal response being the central point (4). Only four subjects recorded 1 or 2 as their response, indicating caffeine content perceived as being lower than usual, whereas ten subjects estimated the caffeine content of the coffee as higher, responding with either 6 or 7.

Perceived purpose of study

An open-ended question asking subjects to describe the purpose of the study was evaluated for any suspicions regarding the presence of the coffee urns, cover story describing the study as one on "office stress," or controllability of noise. One male subject, in the low demand condition with noise, felt that the coffee was part of the study, either to judge effects on ability to work the task or to monitor use in stressful situations. Upon interviewing, the subject acknowledged that he had not thought about the purpose of the coffee until he completed the questionnaire (post-task) and that he felt that he consumed the coffee in a normal fashion. Because of the interview information, his data were retained for analysis. One female subject also expressed suspicion regarding the coffee and did state that

she altered her consumption. Another subject was run in her place. No other suspicions regarding the role of coffee in the study were noted.

Demand manipulation

Suspicions regarding the demand manipulation of pay rates for work performed were evaluated using the open-ended written question and through interview questions. No suspicions were stated in the open-ended written question and only one high demand subject stated that he thought that he would "probably" receive the full $25 during the post-session interview. His data were retained for analysis.

Both high and low demand groups predicted that they would have completed forms for approximately the same number of clients (HD = 4.11, LD = 4.00). The high group, however, completed a significantly greater amount of work, $F(1,60) = 4.60$, $p < .05$, (mean number of clients completed: HD = 2.06, LD = 1.71). The high demand group perceived the work necessary to succeed as being greater than did the low demand group and generally saw the task as more demanding, $F(1,62) = 3.94$, $p = .05$, $F(1,62) = 14.23$, $p < .001$, respectively (see Table 2).

Noise manipulation

Groups exposed to noise reported the noise in the room as being significantly louder than did those not exposed to noise, $F(1,62) = 89.21$, $p < .001$, with HN subjects reporting noise loudness at an average of 4.41 on a seven-point scale

(one representing "not at all" loud and seven being "extremely" loud) and LN reporting an average of 1.59. Both LN and HN groups reported the noise as being uncontrollable on the same seven-point scale (means: LN = 1.25, HN = 1.84), $F(1,62) = 3.35$, $p > .05$

Responses to task demand and noise manipulations

Subjective and physiological responses were assessed at various times throughout the study in order to determine the effectiveness of the manipulations. Each type of measure will be discussed in reference to responses across all subjects over the duration of the study, and differences between task demand and noise manipulation groups.

Subjective responses

Over duration of session. Overall, subjects reported decreases in comfort over the duration of the study, $F(1,89) = 14.22$, $p < .001$,[2] with comfort reported at baseline being greater than at mid-point or end-point measurement times, p's $< .05$. Likewise, reports of feeling stressed increased from baseline to measurement periods during and following the task, $F(1,97) = 16.95$, $p < .001$, with unplanned comparisons significant at $p < .05$. Overall reports of helplessness also changed over time, $F(1,82) = 5.39$, $p < .01$, with end-point reports of helplessness being significantly lower than at the peak level reported at mid-point, $p < .05$. No other mood factors showed changes over the session (see Table 3 for

means).

Demand manipulation. The high demand group reported being more upset by the task, $F(1,62) = 9.18$, $p < .01$, and less able to control the noise, $F(1,62) = 8.27$, $p < .05$, (see Table 2). No differences were found between high and low demand groups on any of the five mood factors.

As can be seen in Table 4, ratings of task demand were also high among the low demand subjects. An effective comparison level of demand would be one that was engaging and not boring, yet not perceived as requiring more than low to moderate levels of effort and not be upsetting. T-tests revealed responses by the low demand group to be greater than the lowest possible ratings on all of the task-relevant questions and greater than the mid-point rating on five out of those seven questions. The pattern of responses indicate that the task was engaging, but that it also required more effort and work, and was more demanding with less perception of control over success than what would be expected for a truly low demand situation (see Table 4).

Noise manipulation. Perceptions of the task situation were affected by noise exposure. Those exposed to noise reported being more upset by the task and more upset by the noise, $F(1,62) = 6.52$, $p = .01$, and $F(1,62) = 38.84$, $p < .001$, respectively. Mean rating of being upset by the task when no noise was given was 3.45 on a seven-point scale (one representing "not at all" and seven "extremely") whereas noise exposure resulted in mean ratings of 4.45. Ratings of being

upset by the noise were 1.69 and 3.91 for low and high noise groups respectively on the same seven-point scale (see Table 5).

Comparisons for each of the five mood factors over the three measurement periods showed main effects for noise exposure associated with greater reporting of irritation on average, $F(1,59) = 7.81$, $p < .01$, (means: HN = 5.80, LN = 3.95), and feelings of lethargy/discomfort, $F(1,59) = 7.76$, $p < .01$, (means: HN = 1.56, LN = -.19). Noise exposure interacted with measurement period on these same mood factors with the groups beginning the session at comparable levels of lethargy/discomfort and irritation, but HN groups reporting greater levels of each of these feelings by the mid-point of the study and maintaining that significantly greater level, $F(2,66 = 7.58$, $p < .01$ and $F(2,71) = 7.03$, $p < .01$, respectively (see Table 6). Additionally, the LN groups reported significant decreases in lethargy/discomfort from baseline to the end of the task (unplanned comparison p's < .05).

Demand by noise interactions. Noise exposure interacted with level of demand only in self-reported level of stress, $F(2,71) = 4.01$, $p < .05$. Tukey HSD tests of means confirmed that the group exposed to noise while working under high demand conditions was the only group to show significant increases in self-reported stress from baseline to end-point (HD/HN mean baseline rating = 6.75; mean end-point rating = 10.50), with that group's final reported stress level being

significantly greater than that reported by the low demand group exposed to noise (LD/HN mean end-point rating = 7.81), p's < .05

Physiological responses

Heart rate change from baseline showed average decreases across the five task periods, $F(4,205) = 85.55$, $p < .001$, for all subjects, with changes being significantly reduced by the third task period, p's < .05, (see Table 7). There also was a significant measurement period within task segment effect on heart rate change from baseline, $F(3,124) = 36.93$, $p < .001$, with comparisons of means showing a non-significant trend for increased heart rate changes over the duration of each segment, p's > .05. No changes in cortisol levels were found between the sample collected at the end of the session and the one collected at baseline.

The demand and noise manipulations resulted in no significant heart rate or cortisol responses. Likewise, demand interactions with noise did not result in any significant effects on physiological responsivity.

Summary

The manipulations of demand and noise were modestly effective in increasing stress levels as noted by increased self-reported negative mood but had no effect on physiological measures of arousal. While both levels of task demand were perceived as being high, and low demand subjects reported levels of demand, upset, and perceived success that would be

consistent with moderately high levels of demand, the high demand groups still reported greater levels of demand and upset than did the low groups. These differences were not reflected in the physiological measures, which showed similar patterns of change among the groups.

Over time, all subjects reported decreases in comfort and increases in stress. Feelings of helplessness decreased significantly between the mid-point of the task and the end of the task. Similarly, heart rate changes from baseline decreased over the duration of the session, although tending to increase within any one 15-minute task period, however post-hoc comparisons of these trends within task period were not found to be significant.

Exposure to noise resulted in reports of greater discomfort and irritation, which increased over the duration of the study. Noise exposure also made the task more upsetting. As expected, no heart rate differences were noted, but expected cortisol differences were not found. Level of demand interacted with noise exposure to increase reported stress among those working under high demand conditions with noise.

Responses to perceptions of demand and control

Two sets of internal analyses were conducted to determine the effects of perceived demand, control, and upset attributed to an uncontrollable event on mood and physiological responses. Median splits were conducted on

responses to the questions, "How demanding did you find the task" for levels of perceived demand, "How much control did you have over succeeding at the task" for levels of perceived control, and "How upsetting did you find the noise" for reported upset related to an uncontrollable event. Groups made up of low and high perceived demand were then combined with high and low levels of the two control-related splits so that combined effects could be assessed. The resulting groups were, first, High Perceived Demand/High Perceived Control (HPD/HPC), N = 17; High Perceived Demand/Low Perceived Control (HPD/LPC), N = 9; Low Perceived Demand/High Perceived Control (LPD/HPC), N = 23; Low Perceived Demand/Low Perceived Control (LPD/LPC), N = 13. The second set of groups consisted of High Perceived Demand/High Upset (HPD/HU), N = 11; High Perceived Demand/Low Upset (HPD/LU), N = 15; Low Perceived Demand/High Upset (LPD/HU), N = 17; and Low Perceived Demand/Low Upset (LPD/LU), N = 20.

Subjective responses

The high perceived demand/low perceived control (HPD/LPC) subjects reported the highest level of irritation by the end of the session, $F(2,70) = 3.51$, $p < .05$, with unplanned comparisons confirming higher ratings compared with HPD/HPC and LPD/LPC groups at the final measurement point and higher irritation than that reported by LPD/HPC at the mid-point measure, p's $< .05$, (see Table 8a). The combination of high demand and low perceived control significantly interacted

with time of measurement for reported comfort, $F(2,90) = 3.13$, $p < .05$, with LPD/HPC reporting highest levels of comfort over time (though comparisons of means were not significant, p's $> .05$, see Table 8a). Main effects for perceived demand or for perceived control were not significant for any mood measure.

Subjects that reported high noise-related upset, compared with the low group, showed higher ratings of irritation and lethargy/discomfort, $F(1,59) = 7.77$, $p < .01$ and $F(1,59) = 7.20$, $p < .01$, respectively. Interactions of high and low upset with time of measurement also showed that high and low subjects started at comparable levels of irritation, lethargy/discomfort, and stress, but that the high group showed significant increases in each of those mood measurements by the end of the task period, $F(2,70) = 6.94$, $p < .01$; $F(2,66) = 5.41$, $p < .01$; $F(2,83) = 3.73$, $p < .05$, respectively (see Table 8b). The combination of perceived demand with level of noise-related upset only resulted in significant effects on comfort, $F(1,59) = 4.25$, $p < .05$ (comparisons of means were not significant, p's $> .05$, see Table 8b).

Physiological responses

Heart rate changes from baseline over the five tasks segments were significantly affected by the perceived demand, perceived control interaction, $F(4,197) = 3.81$, $p < .01$. Comparisons of means revealed the following patterns: by the

end of the session all four groups split on perceptions of demand and control exhibited heart rate responses lower than the responses during the first task segment. However, the task segment during which heart rate changes became significantly lower was different depending on group. By the third task segment, subjects in the HPD/LPC grouping showed significantly smaller heart rate changes compared with first segment responses. HPD/HPC subjects, however, maintained levels of response similar to first task segment responses until the final segment. The other two groups (LPD/HPC and LPD/LPC) showed significant reductions in response by the fourth segment, (p's < .05, see Table 9).

Main effects for perceived demand or for perceived control were not significant for heart rate or cortisol changes. Groups that rated the noise as causing a high level of upset showed average heart rate changes from baseline of -1.27 whereas those reporting low upset showed changes of 1.32, $F(1,55) = 1.12$, $p < .05$. Extent of change, whether positive or negative, was not significantly different, $p > .05$. No other physiological effect of noise-related upset or the combination of that variable with perceived demand were found to be significant.

Summary

Focusing on perceptions of demand and control revealed a number of interactions between these variables on mood and patterns of response. Low perceptions of demand coupled with

high perceptions of control tended to be associated with increased reports of comfort. High perceptions of demand coupled with low perceptions of control over success were associated with the highest final levels of irritation, yet heart rate changes fell below those found in the first task segment earlier for this group. On the other hand, high perceived demand and high perceived control resulted in heart rate responses that remained greater than those found in the first task segment.

Subjects who rated their level of upset attributable to noise exposure as high also reported greater average feelings of irritation and lethargy/discomfort as well as greater increases in those feelings and reported stress over the duration of the study compared with those reporting low noise-related upset. Combining high or low levels of perceived demand with reports of upset had little effect on subjective or physiological responses.

Coping strategies

ANOVAs and t-tests were initially conducted to determine which, if any, demographic and background variables may have had significant effects on use of problem- or emotion-focused coping strategies. Demographic background variables that were found to be significantly related to coping strategies were entered as the first set of the multiple regression correlation (MRC) analyses, being entered prior to other independent variables. Each coping style, and

the ratio between the two, were dependent variables in separate MRC equations. ANOVAs of demand and noise manipulations were conducted with coping scores as the dependent variable. Main and combined effects of the manipulations on coping were all non-significant, p's > .10, and therefore these manipulations were not included in any of the MRC analyses.

Use of emotion-focused, problem-focused strategies and the ratio between the two were also tested as dependent variables in separate MRC analyses each using perceptions of how demanding the task was, perceptions of control over success at the task, and their multiplicative product as independent variables to test for main effects and interactive effects on coping style. Background variables and need for control were entered into each equation prior to testing perceived task demand and perceived control over success. The multiplicative product of perceived demand and success was entered last. Identical sets of analyses were then conducted with perceived demand, reported upset caused by the noise, and their multiplicative product entered as predictors in the last two steps to test for main and interactive effects of these variables on coping styles.

Emotion-focused coping

Comparisons of dichotomous background variables revealed that those who had post-undergraduate education used significantly fewer emotion-focused strategies, $t(61) = 3.11$,

$p < .01$. No other background variable was found to be related to use of emotion-focused coping strategies during the study, so post-graduate education was entered as the sole background variable for subsequent MRC analyses, accounting for a significant change in R^2 of .14, $p < .01$. See Table 10 for regression coefficients (B), changes in R^2, and significance levels for each set and members of sets for the MRC analyses.

The second set was made up only of scores from the desire for control questionnaire. This was found to add non-significantly to R^2, change in $R^2 < .01$. The third set, which was made up of two variables that can be described as general task perceptions, added .08 to R^2 as a set which was marginally significant, $p = .056$. Neither variable alone in the third set, perception of controllability of succeeding at the task and comparability of the task with normal work, reached significance, p's $> .05$.

Task performance and perceptions of how demanding and upsetting the task was made up the fourth set which resulted in a change in R^2 of .14, $p < .01$. Performance, represented as the number of clients each subject completed, resulted in a change in R^2 of .09, $p < .01$, and reported task demand/upset resulted in a marginal increase of .04, $p = .055$. Performance was negatively related to emotion-focused coping, indicating that the more forms that were completed, the lesser the emotion-focused coping score. Reported task demand/upset, however, was positively related to use of emotion-focused coping.

Mood factors were entered as predictors of coping next. Three separate analyses were conducted where all five mood factors at baseline, mid-point, or the extent of change from baseline to mid-point, were entered as the predictor sets. For each of these analyses, the same four previous sets preceded the mood set. The baseline mood set added significantly to R^2 with change in $R^2 = .20$, $p < .01$. How stressed they reported being at baseline contributed .05 in R^2 change, $p = .01$, and baseline helplessness another .03 change, $p = .054$. Each of these were positively related to use of emotion-focused coping, indicating greater levels of reported stress or feelings of helplessness were associated with greater use of emotion-focused coping strategies. No other baseline mood factor led to significant change in R^2.

Mood at mid-point, as a set, resulted in a change of .20, $p < .01$, above the first four sets. Total level of reported stress at mid-point resulted in a significant increase in R^2 of .11, $p < .01$. The direction of the relationship was again positive between reported stress and use of emotion-focused strategies. No other mid-point mood significantly predicted use of emotion-focused coping.

The extent of change from baseline to mid-point also led to significant increases in R^2 over the first four sets, change in $R^2 = .17$, $p < .01$. Extent of change in reported stress accounted for a .04 change in R^2, $p = .03$, and likewise extent of change in feelings of helplessness led to an additional .04 change in R^2, $p = .04$. Greater increases in

reported stress were associated with increased use of emotion-coping strategies, while greater increases in feelings of helplessness were associated with less use of this style of coping.

The final variable tested in relation to emotion-focused coping was the extent that problem-focused coping techniques were employed during the study. This variable contributed a significant .18 increase in R^2 above the first four sets and the mid-point mood level (entered as the fifth set), $p < .001$, and accounted for nearly half of the remaining variance. Use of problem-focused coping techniques was positively related to use of emotion-focused coping techniques. The adjusted R^2 of the entire model that included the first four sets, mid-point mood for the fifth set, and use of problem-focused coping as the sixth set was .73, $F(12,50) = 14.81$, $p < .001$.

A separate set of analyses were then conducted to assess the influence that perceptions of demand, control, and their interaction had on use of emotion-focused coping. No significant changes in R^2 occurred above demographic variables and desire for control for the set containing perceived demand and perceived control over success, or their interaction when emotion-focused coping was the dependent variable. In a similar analysis, entering perceived demand and reported noise-related upset as the third predictor set, a significant change in R^2 of .09 was found, $p < .05$. In this case, perceived demand was found to add .08 to R^2, $p < .05$, but

reported upset did not add significantly, R^2 change = .02. Examination of the regression coefficient indicated that the greater the perceived demand, the larger the emotion-focused coping score.

The interaction of perceived demand with upset also added significantly to R^2, change = .07, $p < .05$. To examine the direction of the interaction, the mean emotion-focused coping scores for each of the four groups created by median splits conducted on perceived demand and upset were calculated. The order of magnitude was LPD/HU = 16.00, HPD/LU = 21.67, LPD/LU = 21.70, HPD/HU = 33.73, with higher means indicating greater use of emotion-focused coping. High perceived demand in combination with high noise-related upset resulted in the greatest use of this style of coping.

Problem-focused coping

Problem-focused coping strategies, like emotion-focused coping, were used less by those who had post-undergraduate education, $t(60) = 3.14$, $p < .01$. Again this was the only background variable to be significantly related to use of this style of coping and was the only one entered for the MRC analyses. Demand and noise manipulations did not lead to significant differences in use of problem-focused coping, p's > .10, and were not included in the MRC equation. The structure of the MRC analyses were the same as that described for emotion-focused coping with variables entered in the same order. The results are presented in Table 11.

Post-undergraduate education contributed a .14 increase in R^2, $p < .01$. The sets of variables labeled as desire for control, task performance and reported task demand/upset, mid-point mood factors, and extent of use of emotion-focused strategies each added significantly to R^2 above previously entered sets. Increases in R^2 for the sets were: desire for control, .09, $p < .01$; task performance and reported task demand/upset, .10, $p = .02$; mid-point mood factors, .12, $p = .05$; and emotion-focused coping, .23, $p < .001$. The remaining sets did not lead to significant increases in R^2.

Individual members of sets that contributed significantly to R^2 were desire for control, R^2 change = .09, $p < .01$, reported task demand/upset, R^2 change = .05, $p = .03$, mid-point irritation, R^2 change = .06, $p = .02$, mid-point lethargy/discomfort, R^2 change = .06, $p = .02$, and use of emotion-focused strategies, R^2 change = .23, $p < .001$, leaving a residual variance of .44. With the exception of mid-point irritation, each of these variables were positively related to use of problem-focused coping, indicating that as one increased so did use of this style of coping. Mid-point irritation, on the other hand, was related negatively, indicating that greater levels of irritation were associated with lesser use of problem-focused strategies. The total model, including sets one through four, mid-point mood factors as set five, and emotion-focused coping as set six, accounted for an adjusted R^2 of .66, $F(12,50) = 10.84$, $p < .001$, with

over one-third of the variance being accounted for by use of emotion-focused strategies.

In subsequent analyses, no significant changes in R^2 occurred above demographic variables and desire for control for the set containing perceived demand and perceived control over success, or their interaction, when problem-focused coping was the dependent variable. Likewise, sets containing perceptions of demand, reported noise-related upset, and their interaction were found to add non-significantly to R^2.

Ratio of emotion- to problem-focused strategies

In order to determine factors predicting preference for one style of coping over the other, the ratio of emotion- to problem-focused coping scores (e/p ratio) was also entered as a dependent variable. The e/p ratio was found to be related to income and marital status. Subjects who were single or who reported earning less than $10,000 per year on average reported using a greater proportion of emotion-focused strategies, $t(60) = 2.27$, $p < .05$ and $t(60) = 2.15$, $p < .05$, respectively. Additionally, the e/p ratio was negatively associated with being widowed and with earning $20-30,000 per year, $t(60) = 2.11$, $p < .05$ and $t(60) = 2.03$, $p < .05$, respectively. Neither demand or noise manipulations resulted in significant differences in the ratio of e/p coping strategies, p's $> .05$, and were not included in the MRC equations.

The four background variables that were significantly

related to the e/p ratio were entered as the first set in a MRC analysis with the e/p ratio as the dependent variable. The set of background variables led to an increase in R^2 of .16, p = .03, but no single variable showed a significant increase in R^2, p's > .05. The order of sets and variables entered and the manner of entry were again identical to that described for emotion-focused coping, except that neither use of emotion- nor problem-focused techniques were entered as independent variables as the sixth set (see Table 12).

The second set, desire for control, did not contribute significantly to R^2, p > .05. Responses to the set of questions regarding how controllable success at the task was and how closely the laboratory situation compared to normal work settings added .08 to R^2, p = .056. Both questions in this set each accounted for a .06 increase in R^2, p's = .03. The direction of the relationships with the e/p ratio indicated that the more normal or controllable the task was seen as being, the more the ratio favored use of problem-focused techniques. The third set, related to task performance and perceived demand, led to additional changes in R^2 of .14, p < .01, with the number of forms completed accounting for a .09 increase in R^2, p < .01, and reported task demand/upset accounting for a marginal .04 increase, p = .055. The direction of the relationships reflected that the greater number of forms that were completed, the more the ratio favored problem-focused coping over emotion-focused, while greater perceptions of demand and being upset by the

task favored use of emotion-focused coping strategies.

Of the three sets of mood factors tested, baseline, total mid-point score, and extent of change from baseline to mid-point, only the baseline mood factor set led to significant increases in R^2, change = .13, p = .03. Of that set, only feelings of helplessness contributed significantly to R^2, with a change of .09, $p < .01$. The direction of the relationship indicated that greater baseline levels of helplessness were associated with greater use of emotion-focused strategies relative to problem-focused. Mid-point mood factors and extent of change between baseline and mid-point failed to change R^2 significantly above the first four sets. The entire model, including sets one through four and the set containing baseline mood as the fifth set accounted for an adjusted R^2 of .42, $F(14,48) = 4.21$, $p < .001$.

Analyses entering perceptions of demand, control over success, and their multiplicative product in addition to background variables and desire for control were found to significantly predict e/p ratio. The set comprised of perceived demand and perceived control added .15 to R^2, $p < .01$, with each of the two variables contributing significantly to R^2: perceived demand, R^2 change = .09, p = .01; perceived control, an additional R^2 change = .05, $p < .05$. Based on the regression coefficients, as perceived demand increased, the ratio favored use of emotion-focused strategies, but as perceptions of control increased, the ratio favored problem-focused.

The interaction of perceived demand in combination with perceived control over success resulted in an additional change in R^2 of .06, $p < .05$. To examine the direction of the interaction, the mean e/p ratio scores for each of the four groups created by the median splits conducted on perceived demand and perceived control were calculated. The order of magnitude was LPD/HPC = .86, HPD/HPC = .97, LPD/LPC = 1.06, HPD/LPC = 1.52, with higher means reflecting greater use of emotion-focused coping in proportion to problem-focused techniques used. The pattern of means indicated that low demand with high perceptions of control over success was associated with greater preference for problem-focused coping over emotion-focused strategies, with the opposite occurring when demand was high but perception of control was low. The pattern also reflects that perceived demand acted as a moderator for the effects of perceived control on coping styles, in that high control consistently is associated with lower e/p ratios (reflecting lesser preference for emotion-focused coping) and low control with higher (reflecting more emotion-focused coping).

The combination of perceived demand with level of noise-related upset had similar outcomes as those described above for perceived demand with perceived control over success. The set containing perceived demand and noise-related upset added significantly to R^2 above the background variables and desire for control by .11, $p < .05$. Examination of the extent that the individual members of the set added to

the equation revealed that only perceived demand accounted significantly for the increase in this set, R^2 change = .11, $p < .01$, with the association positive as stated previously. The perceived demand by noise-related upset interaction added significantly to R^2, change = .06, $p < .05$. Examination of the means of the groups created by median splits showed e/p ratios of: LPD/HU = .78; HPD/LU = .89; LPD/LU = 1.06; HPD/HU = 1.54. A markedly higher e/p ratio is seen for those who perceived high demand while being more upset by the noise, indicating a preference for emotion-focused coping under those conditions.

Number of coping items endorsed

It had been hypothesized that high demand with uncontrollable noise should lead to the greatest number of coping strategies used (total) and low demand without exposure to noise the least. As has been previously noted, the demand and noise manipulations were ineffective in altering coping responses. Therefore, perceptions of demand, control over success, and their interaction were tested as predictors in one analysis and perceptions of demand, reported noise-related upset, and their interaction were tested as predictors in a separate analysis with total number of coping strategies endorsed as the dependent variable.

As done in the previous MRC analyses, background variables were tested first. Those who had post-undergraduate education used fewer coping strategies, $t(61) = 3.57$, $p < .01$,

as did those that owned their own home, $t(61) = 2.59$, $p < .05$. These two background variables, entered as a set, contributed .22 to R^2, $p < .01$. Individually, post-undergraduate education added .13 to R^2, $p < .01$, and home ownership added an additional .06, $p < .05$. Entering desire for control changed R^2 an additional .05, $p < .05$, with the regression coefficient indicating a positive relationship between desire for control and total number of coping strategies endorsed.

Perceived demand and perceptions of control over success were then entered as a set, and the set was found to increase R^2 by .09, $p < .05$. Only perceived demand, from this set, significantly increased R^2, change = .09, $p < .01$. The direction of association indicated that increased perceptions of demand were associated with greater numbers of coping strategies used. The interaction between perceptions of demand and control over success did not contribute significantly to R^2 (see Table 13).

Entering perceived demand and reported noise-related upset as a set, instead of perceived demand with perceived control over success, also led to a significant increase in R^2 of .11, $p < .01$. Again, only perceived demand added significantly to R^2, change = .08, $p < .01$. However, the perceived demand, noise-related upset interaction did result in significant increases in R^2, change = .05, $p < .05$ (see Table 13). Examination of the mean number of coping responses endorsed by each of the four groups created by median splits showed the following order of magnitude: LPD/HU = 18.06;

LPD/LU = 21.40; HPD/LU = 22.00; and HPD/HU = 29.91. High perceived demand in combination with high noise-related upset resulted in the greatest number of coping strategies chosen.

Summary

Although demand and noise manipulations did not significantly contribute to the variance explaining coping styles used, a number of other factors did. Beyond the demographic variables, desire for control was positively related with the total number of coping strategies used, and specifically use of problem-focused, but not emotion-focused coping. How controllable success at the task was perceived as being was related to the approach of coping, in that greater perceptions of control were associated with a preference of problem-focused coping over emotion-focused techniques. The interaction with perceptions of task demand served to moderate this relationship such that greater levels of perceived demand led to relatively more preference for emotion-focused techniques. This was the case even though perceptions of demand and how upsetting the task was seen as being were associated with increased use of both types of coping.

Actual performance on the task, as measured by number of clients' forms that were completed, also affected styles of coping. Greater numbers of forms completed were associated with a lower e/p ratio. This seemed to be because of the negative association with emotion-focused coping rather than

because of any relationship with problem-focused techniques, the latter of which were non-significantly affected by performance. Perceptions of demand affected coping scores through effects on use of emotion-focused strategies with coping effects being accentuated by how upsetting noise was perceived as being.

Mood affected the different modes of coping and the ratio between the two in differing ways. How much stress was reported at baseline, and the extent that the reported stress increased following baseline, were associated with greater use of emotion-focused styles of coping, but not problem-focused coping or the e/p ratio. Irritation at task mid-point was associated with lesser use of problem-focused coping while increased lethargy/ discomfort at the same time point was associated with greater use of this same set of strategies. Feelings of helplessness, on the other hand, showed mixed and varied associations. Higher baseline levels of helplessness were modestly associated with increased reporting of emotion-focused coping and the e/p ratio also showed a positive relationship with this variable at mid-point. However, the extent of increase in helplessness was negatively associated with emotion-focused coping.

Coffee consumption

Similar to analyses of coping strategies, t-tests were conducted with dichotomous background variables as independent variables and coffee left in the urn as the dependent

variable. MRC analyses, where coffee left in the urns was entered as a dependent variable, were conducted similarly to those described for coping strategies. Background variables were entered as the first set; variables related to patterns of use (i.e., usual daily intake of coffee, self-reported changes in consumption when under stress) were entered as the second set; and the third set included variables that may have had direct transient effects on the amount of caffeine consumed in the laboratory (i.e., use of coffee and other caffeine the day of the study, consumption of herbal tea during the session). The fourth set was made up of responses to questions regarding how closely the beverages compared to usual beverages consumed. Task performance was entered fifth, followed by two mood factors found to be correlated with coffee consumption: lethargy/discomfort and helplessness. These two factors were entered together as sets for baseline, mid-point, and the extent of change from baseline to mid-point. Each of those three mood sets were entered separately as the sixth set in the equation, as done in the coping analyses. The final set contained problem-focused and emotion-focused coping scores and was then re-run substituting the e/p ratio as the only variable in the set. A second MRC analysis was then conducted with proportion of coffee consumed in the laboratory to that normally consumed as the dependent variable (see Tables 14 and 16).

Coffee left at end of session

Only four subjects did not consume any coffee during the lab sessions while 47 did not consume any herbal tea. Volume of coffee left ranged from 415 to 970 ml (mean = 701 ml, s.d. = 151.5). Males had significantly less coffee left at the end of the session than did females, $t(61) = 2.33$, $p < .05$, and those who had completed at least some college had more coffee left at the end, $t(61) = 2.84$, $p < .01$. No other background variables were found to be related to amount of coffee left, nor were demand or noise manipulations, p's $> .05$.

Gender and having had some college education, as the only two background variables found to be significantly related to volume of coffee left, were entered together as the first set. The set added .17 to R^2, $p < .01$. Attending college led to the greatest increase in R^2, change = .09, $p < .01$, with gender adding .05 more, $p = .05$. Coffee use patterns added, as a set, .12, $p < .01$. Usual daily consumption of coffee contributed a non-significant increase of .04 while reported use of caffeine during stress led to a change in R^2 of .08, $p = .01$. The direction of the relationship indicated that self-reporting increased use during stress was associated with a lesser volume of coffee left in the urn at the end of the session, reflecting greater consumption.

The set identified as consumption of other beverages the day of the study contributed an additional .08 change to R^2, $p < .05$, with only tea left at the end of the session

adding significantly to R^2, change = .08, p = .01. The directions of the relationships indicated that the more tea that was left at the end of the session, the smaller amount of coffee was left. Consumption of coffee or other sources of caffeine prior to the session did not account for a significant percentage of the variance.

Comparability of the beverages and breaks used in the study were tested in the fourth set which was found to lead to a significant change in R^2 of .09 over the previous three sets, p = .01. Both comparability of the breaks and the beverages consumed during breaks to usual breaks and beverages normally consumed each added .05 to R^2 above previously entered variables, p's = .02. The direction of the relationships of both variables indicated that the more comparable breaks and beverages were to the norm, the lesser the volume of coffee that was left at the end of the session.

Task performance and mood factors at baseline, mid-point, or the extent of change between the two time points, failed to contribute significant increases in R^2 above the previous sets. Coping strategies, tested as the seventh set, resulted in a .06 change in R^2 above the previous six sets (mid-point mood factors were entered sixth), p =.05. Of the two individual strategies of coping, only emotion-focused coping added significantly to R^2 with a change of .04, p < .05. This strategy of coping was related to coffee consumption in that the larger the emotion-focused coping score, the more coffee that was left at the end of the

session, reflecting less consumption. This pattern was seen also when the ratio of e/p coping was substituted as set seven. This ratio resulted in a change in R^2 of .05, p = .02, and the relationship indicated that the greater the balance of coping was in favor of emotion-focused strategies, the more coffee that was left in the urn.

The variance accounted for by the entire model, which included college attendance, gender, usual use of coffee, use of caffeine during stress, caffeine intake prior to the session, volume of herbal tea left at the end of the session, the comparability of laboratory refreshments and breaks to normal, task performance, mid-point levels of lethargy/discomfort and helplessness, and problem- and emotion-focused strategies of coping, was an adjusted R^2 of .41, $F(13,49) = 4.29$, $p < .001$.

The effects of perceived demand, perceived control over success, and their interaction on coffee consumption were assessed in a separate set of analyses as was perceived demand, noise-related upset, and their interaction. For each of these analyses, demographic variables (having attended college and gender) and beverage intake variables (usual daily coffee consumption, caffeine consumed prior to the study, and tea consumed during the study) were entered prior to the set containing the two individual perception variables (either perceived demand and perceived control over success or perceived demand and reported upset). The appropriate multiplicative product of either perceived demand with

perceived control or perceived demand with reported upset was then entered. None of these perception variables or their interactions contributed significantly to R^2 above that already added by the background and consumption variables (see Table 15).

Ratio of coffee consumption in lab to normal use

Ratio of estimated consumption of coffee in the lab to self-reported usual consumption ranged from .00 to .51 (mean = .20, s.d. = .131). The ratio of coffee consumed in the lab to normal consumption was negatively correlated with the number of family members living within 30 miles of a subject, $r = -.28$, $p < .05$. Additionally, those who lived in rural communities drank a lesser proportion of their normal consumption in the lab, $t(60) = 2.31$, $p < .024$, as did subjects who had completed at least some college, $t(60) = 2.68$, $p < .01$. Those who were living with people other than relatives drank a greater proportion, $t(60) = 3.49$, $p < .01$. Other background variables and demand and noise manipulations were not found to be related to the ratio of consumption, p's $> .05$.

The MRC analyses for ratio of consumption were identical to those described for volume of coffee left in the urns (see Table 16), with exception of the first set which included the aforementioned significantly related background variables. This first set resulted in a change in R^2 of .26, $p < .01$. Living with people other than relatives added .05,

$p = .05$, and having attended college contributed an additional change of .06, $p = .04$. The other two members of this set did not add significantly to R^2.

The second set, containing variables reflecting usual patterns of coffee use, resulted in a change in R^2 of .12 above the first set, $p < .01$. Both members of this set resulted in significant changes in R^2, usual daily intake added .07, $p = .03$, and use of caffeine when under stress an additional .07, $p = .01$. Greater levels of usual intake were associated with smaller proportions consumed in the lab while self-reported increases in use during stress was associated with greater proportions of consumption. The third set of variables that reflected use of caffeine prior to the session and consumption of herbal tea during the session resulted in non-significant changes in R^2.

Comparability of breaks and beverages, represented in the fourth set, led to a significant change in R^2 of .06, $p < .05$. The only member of this set to add significantly to R^2 was comparability of beverages to normal beverages consumed at breaks, with a change in R^2 of .05, $p < .05$. The more comparable the beverages were to normal, the greater the proportion of usual consumption that occurred. Task performance, set five, did not contribute significantly to R^2, $p > .05$.

Entering the baseline mood factors of lethargy/ discomfort and helplessness as set six resulted in an increase in R^2 of less than .01, $p > .10$. Substituting mid-point

measures of these factors, however, did result in a significant change in R^2 of .06, $p < .05$. Total level of reported helplessness at this time point added .06 to R^2 over previously entered variables. The direction of the relationship indicated that greater levels of helplessness at this time point was related to a greater proportion of coffee being consumed during the session. Extent of change from baseline to mid-point did not contribute significantly to R^2, $p > .05$.

Coping strategies, entered as set seven, added .05 to R^2, $p < .05$. Use of emotion-focused strategies, and not use of problem-focused, led to a significant change in R^2 of .04, $p = .03$. The more that emotion-focused strategies were used, the lesser the proportion of normal coffee intake that was consumed during the session. Likewise, substituting the e/p ratio for the coping strategies led to a change in R^2 of .05, $p = .02$, with the direction indicating that greater use of emotion-focused strategies in comparison to problem-focused strategies was associated with a lesser proportion of coffee being consumed in the laboratory.

The total adjusted R^2 of the model that included all of the background variables in set one plus the same variables that had been entered for the analysis of coffee left in the urn was .51, $F(15,47) = 5.32$, $p < .001$.

Perceptions of demand, control, and their interaction were assessed as predictors of coffee consumption with the background demographic variables (i.e., number of family

members living within 30 miles, living in a rural community, and having completed at least some college) and consumption variables (usual daily coffee consumption, caffeine consumed prior to the study, and tea consumed during the study) entered prior to the perception variables. As with the other measure of coffee consumption, perceived demand, perceived control over success, and their interaction added only non-significantly to R^2 (see Table 17).

Similarly, perceived demand and reported upset attributed to the noise were entered as a set following the background and consumption sets, adding .08 to R^2, $p < .05$. Perceived demand accounted for a non-significant increase in R^2 of .03, but reported noise-related upset added .04 more to R^2, $p < .05$. The sign of the regression coefficient indicated that the greater the reported upset, the lesser proportion of normal daily coffee was consumed at the laboratory. The perceived demand, reported upset interaction added a non-significant amount to R^2 that was less than .01 (see Table 17).

Coffee consumption as a function of stress

Coffee consumption as a function of self-reported changes in use when under stress and perceived stress levels was further investigated by designating subjects as those who reported using caffeine more when under stress (IC) in contrast to those whose caffeine intake was reported as remaining the same or decreasing during stress (NC) in a set

of internal analyses. There were 26 who reported that they tend to increase use and 37 who reported that they do not change use or use less (only four claimed decreased use during stress). This variable was not associated with claims of developing headaches when caffeine use was avoided, usual daily use, or age started drinking coffee, p's > .05.

Main effects for IC versus NC were found for both coffee left in the urn and the lab-to-normal coffee consumption ratio, $F(1,59) = 3.90$, $p = .05$ and $F(1,59) = 5.64$, $p < .05$, respectively. IC subjects were found to have left less coffee in the urn at the end of the session (mean = 661.4 ml) and drink a greater proportion of their daily intake during the session (mean = .25) than did NC subjects (means = 733.9 ml and .16 for volume of coffee left and proportion consumed, respectively). IC or NC designation in combination with demand and/or noise manipulations had no effect on coffee consumption, p's > .05

IC and NC were crossed with high and low levels of the five mood factors at the three time points and task perceptions, designated through median splits. Groups formed by these splits ranged in size from 10 to 24 subjects and varied depending on the analysis. Coffee left in the urn and ratio of consumption were entered as dependent variables in ANCOVAs with total usual consumption and consumption of caffeine prior to arrival at the lab entered as covariates. Only interactions were analyzed because main effects were reflected in MRC analyses.

Volume of coffee left in the urn was significantly affected by the interaction between stress use and reported helplessness at mid-point, $F(1,62) = 4.36$, $p < .05$. Unplanned comparisons of means confirmed that those who reported normally consuming more caffeine under stress had significantly less coffee left at the end of the session if they also had reported high levels of helplessness at the mid-point (mean volume left = 613.1 ml) compared to those who reported high helplessness but claimed less/same consumption under stress, who had the most left (mean = 766.2 ml), $p < .05$.

Reported coffee use under stress also interacted with reported lethargy/discomfort at the mid-point of the session to affect volume of coffee left, $F(1,62) = 4.23$, $p < .05$. Comparisons of means reflected a non-significant trend toward IC/high discomfort leaving the smallest volume with NC/high discomfort leaving the largest volume (means = 638.6 ml and 782.6 ml, respectively), $ps > .05$.

The interaction of reported use during stress with the number of problem-focused strategies used during the session also significantly affected volume left at the end of the session in the same pattern as that described for helplessness and discomfort, $F(1,62) = 4.58$, $p < .05$. Comparisons of means reflected a significantly smaller volume of coffee left by those who were designated as IC who also used a larger number of problem-focused strategies when compared to those who used a large number of problem-focused

strategies yet were designated as NC (means = 631.3 ml and 798.7 ml, respectively), $p < .05$.

Very similar patterns emerged when the ratio of coffee consumed in the lab to usual use was the dependent variable. Ratios of consumption were highest for the group that claimed increased use under stress and greater lethargy/discomfort at mid-point or end-point, $F(1,61) = 7.28$, $p < .001$, and $F(1,61) = 6.50$, $p = .01$, respectively. The IC subjects who also reported high levels of lethargy/discomfort at either measurement point had a mean consumption ratio of .31 which was significantly higher than any of the other groups which showed ratios ranging from .14 to .19.

The combination of IC or NC designation with helplessness reported at baseline was significant, $F(1,61) = 4.28$, $p < .05$. In this case, the group who reported same/less consumption during stress when reporting greater levels of helplessness at baseline ended up consuming the smallest ratio, significantly less than either group claiming to increase consumption during stress, (mean ratios: NC/high helplessness = .10, IC/low helplessness = .25, IC/high helplessness = .25), $p's < .05$.

Summary

The total amounts of variance explained by the MRC analyses of coffee left in the urn and of the ratio of consumption in the lab to normal daily consumption were 41% and 51%, respectively. The majority of this variance was

explained by differences that individuals brought to the laboratory in the form of demographic differences, usual intake of coffee, and patterns of intake during stress. Other variables that contributed to explaining the variance were mostly incidental: consumption of herbal tea during the session and how comparable the beverages and breaks were to normal situations.

Beyond these background variables, feelings of helplessness at the mid-point of the task significantly added to R^2 for the ratio of coffee consumed during the session to normal consumption. The regression coefficient indicated that the relationship was positive, reflecting greater rates of consumption of coffee in the lab among those who had higher helplessness ratings.

Use of emotion-focused strategies also contributed significantly to R^2 and was positively related to the amount of coffee left in the urn, again reflecting greater use of emotion-focused coping being associated with less consumption of coffee. The same association was found for the analysis of ratio of consumption in that increased use of emotion-focused coping was associated with a lesser proportion of normal daily consumption occurring in the laboratory. That there was an association between emotion-focused coping and coffee consumption in the lab was reiterated when the e/p ratio was entered as a predictor in the equations, again adding significant changes to the R^2's of the consumption variables. The direction of the relationships indicated that

favoring emotion-focused coping was associated with lesser total consumption in the lab as well as smaller proportions of daily coffee being consumed during the task session. Relatedly, greater levels of upset caused by the noise were associated with a lesser proportion of coffee consumed.

A sub-group of the sample reported using caffeine more during times of stress (n = 26). The balance of the sample primarily reported no change in consumption, with four subjects reporting decreases. Usual use of caffeine in combination with stress was not related to total levels of usual consumption or to factors that normally would be thought of as indicating caffeine addiction, such as headache upon withdrawal, or age that coffee drinking began. However, the group that reported that they increase consumption during stress had less coffee left at the end of the session and consumed a greater proportion of their normal daily intake during the session.

Further differentiation of those who claimed to increase use during stress from those who did not occurred with two subjective measurements: how lethargic/ uncomfortable they felt and how helpless they felt at baseline or mid-point. In general, those who were high on the mood ratings and claimed to increase use during stress consumed the most coffee and those who were high on the mood rating but claimed no change or decrease in caffeine intake during stress consumed the least. Those who were low on the mood ratings tended to consume amounts between those of the other two groups.

Similar interactions occurred with ratio of lab to normal intake as the dependent variable on the same two mood factors.

Finally, the number of problem-focused strategies used during the study interacted with self-reported use of caffeine under stress. Analysis of the interaction indicated that those who reported generally increasing caffeine intake during stress and who used a larger number of problem-focused strategies consumed the largest amount of coffee in the laboratory; the ones who indicated generally having no changes in consumption or a decrease and who used more problem-focused strategies consumed the smallest amount.

Discussion

The main objective of the present laboratory research was to clarify the role of coffee consumption during stress and to determine whether it plays a coping function. More specifically, whether coffee serves emotion-focused, problem-focused functions, or both, was to be tested. As part of this investigation, the assumption that situations perceived as being controllable would increase use of problem-focused techniques, whereas exposure to uncontrollable, unpleasant situations would increase use of emotion-focused techniques was also evaluated. Experimental manipulation of stress and self-report information regarding coffee consumption, stress levels, and responses were used to test these relationships.

The manipulations of demand and noise resulted in predicted changes in mood, reflecting increased stress when demand was high and noise was experienced, but the demand manipulation did not result in expected heart rate and cortisol increases and noise exposure did not result in expected cortisol increases. Further, the manipulations did not result in predicted differences in coping behaviors or coffee consumption. Self-report information, however, was useful for identifying individual differences in perceptions of stress and caffeine-use patterns and were therefore useful for clarifying the stress, coping, and coffee-use relationships.

The results of the internal analyses of perceptions

and individual differences indicated that coping styles were affected by perceptions of demand and control, with greater levels of control being associated with use of more problem-focused strategies and increased levels of demand and upset being associated with greater use of emotion-focused techniques. Additionally, upsetting uncontrollable noise and use of emotion-focused coping were negatively associated with coffee consumption relative to normal daily use and total laboratory coffee consumption, respectively. Conversely, greater feelings of helplessness positively predicted percentage of normal intake.

A sub-group reported generally using more caffeine when experiencing stress (IC) and their coffee consumption was compared with those who reported no change in consumption during stress or a decrease (NC). The IC group drank more coffee overall and at a greater proportion of normal daily intake than did the other group. The IC subjects also consumed more coffee in conjunction with problem-focused strategies and under situations where they felt uncomfortable or helpless, whereas the NC subjects tended to consume less coffee under those conditions. Results of this study indicated that person-situation interactions govern whether stress leads to increases in coffee consumption.

Each of the three hypotheses will be discussed in the following sections along with supporting or refuting evidence from the present research. Additionally,

implications for research on stress and coffee consumption will be discussed.

Responses to demand and control

Demand was manipulated through instructions affecting the contingency of reward for work performed. Both low and high demand conditions were intended to appear to be controllable, or do-able, by subjects, but the high demand condition required greater work output for an equivalent level of pay. The need to perform at a higher level in the high demand situation was hypothesized to result in greater use of problem-focused techniques to increase likelihood of success. Level of demand was crossed by exposure to an uncontrollable, noxious stimulus (loud, periodic noise) among half of each of the high and low demand situations.

As expected, high demand subjects found the task to be more demanding and to require more work for success than did low demand subjects. This occurred even though low demand subjects also found the task to be demanding and to require effort. The noise manipulation was also successful in that the noise was reported as being loud and uncontrollable by those exposed to it.

Subjective responses to the task and noise were measured using two separate questionnaires: one that asked specifically about feelings associated with the task or noise and the second which asked about general moods and

feelings prior to, during, and following the task period. The responses on these two forms paralleled the descriptions of the high demand situation as being more demanding and the noise as being loud and uncontrollable. High demand subjects referred to the task as being more upsetting and exposure to noise led to descriptions of both the task and the noise as being more upsetting. Noise exposure was also associated with greater feelings of irritation and discomfort in general while the combination of high demand and noise was associated with greater reported stress. Therefore, self-report measures were consistent among themselves and confirmed that higher demand and exposure to uncontrollable noise was stressful.

Pilot tests of the demand manipulation had indicated that increased blood pressure responses could be expected over the duration of the 1.5 hour task. Blood pressure was not measured in the present study because of concerns that subjects would have felt restricted in obtaining coffee if encumbered by a cuff and because of recent articles in the popular press regarding coffee consumption and blood pressure.

Physiological responses measured in the present study did not corroborate the predictions of increased stress responses to high demand and noise exposure. Heart rate measures, for example, were not consistent with the general mood responses. On the average, subjects reported increased levels of feeling stressed and decreased levels of

feeling comfortable over the duration of the study, but heart rate responses declined significantly over the same time period. Adaptation of heart rate responses to the situation is likely given the length of the task. Cortisol measurements also did not differentiate between high and low demand or noise groups.

In sum, exposure to noise was expected to result in increased levels of negative mood, whereas different levels of demand were not. The mood measurements are fairly consistent with those predictions with high demand only leading to greater reports of stress when combined with noise. However, indicators of demand, such as physiological responses, were minimally different between groups.

The level of demand perceived by the low demand subjects may partially explain the lack of differences found between the groups. Subjects in the low demand groups rated the task as being demanding and upsetting and indicated they put a great deal of effort (mean = 6.28 on a seven-point scale) into the task. Their self-report ratings might indicate that the task under low-demand instructions was still moderately to highly demanding. This unexpectedly high rating of demand in the low demand conditions may have been due to perceptions of success generated by subjects themselves. They predicted that the average amount of work that could be completed during the time period was just over four clients. No individual in the study completed that many forms and the average completion rate was half that

predicted by subjects. Given the actual completion rate compared with the predicted rate, feelings of failure may have occurred without explicit demands being placed on subjects to perform at a specified level.

Because of the variability in responses within groups, and the lack of differentiation between the high and low demand groups, internal analyses based on perceptions of demand and control were conducted. Subjects were split based on self-reports of how demanding the task seemed and how much control they perceived having over being successful at it. Subjects who thought the task was highly demanding while perceiving that they had little control over their success at it (HPD/LPC) reported significantly higher levels of irritation. Perceived demand and control also combined to affect reports of comfort, with perceptions of low demand and high control (LPD/HPC) resulting in non-significantly higher reports of comfort.

Levels of task difficulty have previously been found to affect heart rate responsivity, with moderately difficult tasks leading to the largest responses compared with easy or overly difficult tasks (Light & Obrist, 1983). Light and Obrist explained the lower responses in the latter cases as being from the lack of challenge if the task is too easy, or because of giving up if too difficult. Similar patterns were found in the present study. All four groups (LPD/LPC, LPD/HPC, HPD/LPC, HPD/HPC) showed initial increases in heart rate from baseline and significantly reduced heart rate

responses by the end of the session. However, the task segment during which they reached that point was different depending on group. By the third task segment, subjects in the HPD/LPC grouping showed significant reductions in heart rate changes compared with first segment responses. HPD/HPC subjects, however, did not reach a significant reduction in heart rate changes compared with the first task segment until the final task segment, and the other two groups (LPD/HPC and LPD/LPC) reached significant reductions by the fourth segment. In this situation, high perceived demand with low control over success mimics responses found when tasks are too difficult. On the other hand, those who perceived high demand but still felt that they had control over their succeeding at the task showed responses commonly found with moderately difficult challenge.

A second set of internal analyses were conducted based on groups formed by splitting subjects on perceptions of demand and level of reported upset resulting from exposure to uncontrollable noise. In these analyses, a number of the general mood ratings were found to be consistent with the reported upset attributed to the noise. People reporting high levels of upset from the noise (HU) reported greater levels of irritation, lethargy and discomfort, and significant increases in those mood factors from baseline to mid-point. Subjects who reported being more upset by the noise also showed significant increases in reported stress compared to those reporting low levels of

upset (LU). Those who reported low levels of noise-related upset showed average heart rate increases while HU averaged decreases.

While being associated with a number of negative moods, being upset by an uncontrollable source of noise did not interact with perceived levels of demand in any appreciable way. Reported levels of comfort were affected by the combination of perceived demand and noise upset, but comparisons of means failed to clarify the source of the effect. In all, being upset by an uncontrollable source of discomfort, separate from the source of demand, did not interact with levels of demand to affect moods or other responses. In contrast, high demand in combination with low levels of control over the same source resulted in greater reported discomfort and stress and resulted in physiological responses consistent with giving up.

In summary, the data suggest that the task situation was challenging, but also suggests that personal perceptions of demand and ability to succeed outweighed instructions given in determining responses. The noise was perceived as noxious and uncontrollable as intended and when presented with the high demand condition created greater levels of perceived stress. Those who reported being upset by the uncontrollable noise also reported greater irritation, discomfort and stress. In addition, perceptions of higher demand in combination with perceptions of low control over success produced greater levels of irritation and patterns

of heart rate response consistent with giving up while high perceived demand with high perceived control showed patterns of heart rate response consistent with perseverance.

Coping

Exposure to uncontrollable noxious stimuli was hypothesized to lead to increased emotional regulation by using more emotion-focused techniques since nothing could be done to prevent or end the exposure. Greater levels of demand for which success was under the control of the subject was hypothesized to lead to more use of problem-focused strategies. Use of the two styles of coping were assumed to be additive with high demand subjects exposed to uncontrollable noise using the greatest number of coping techniques, both problem- and emotion-focused, and low demand/low noise subjects the least. These expected effects on coping styles were also tested with perceived levels of demand and control within the same situation and with perceived levels of demand and upset associated with a separate uncontrollable source.

In order to test the effects of demand and absence of control on coping, the present study manipulated situational demand and exposure to uncontrollable noise. Although the task manipulation was perceived as demanding and noise led to predicted changes in mood, use of coping strategies were not affected by these manipulations. As was noted previously, high demand resulted in task ratings that

were more demanding and upsetting, but the low demand groups also interpreted the task as being demanding, and upsetting. Given the nature of the low demand task, different styles of coping may not be expected between the two and, in fact, were not found. Additionally, controllability of stress was not manipulated, but rather the presence or absence of an uncontrollable, unpleasant, event was studied. The noise was rated as loud and upsetting and on average resulted in increases in reported irritation and lethargy/discomfort, but did not result in predicted coping responses.

To understand ways in which demand and exposure to uncontrollable stimuli may have affected coping behaviors, effects arising from demographic or other background differences needed to be tested. A number of studies have reported gender as being significantly related to styles of coping, specifically noting that women tend to use more emotion-focused techniques and men more problem-focused (Billings & Moos, 1981, Folkman & Lazarus, 1980; Stone & Neale, 1984; Vingerhoets & Van Heck, 1989; Viney & Westbrook, 1982). Other studies have not reported these differences (Collins, Baum, & Singer, 1983; Hamilton & Fagot, 1988; Patterson et al., 1990). The present study found no effects of gender on coping preferences. The differences in coping, when they occur, may not be gender-specific patterns of behavior as much as products of differences in appraisal or in the types of events that are encountered (Kessler, Brown, & Broman, 1981). In the

present study, there were no gender differences in interpretations of the task or in responses to it.

Other demographic variables have not been referred to as consistent sources of explanation for styles of coping, with the exception of age (McRae, 1984; Thompson et al., 1990). No effects of age on coping styles were found in the present study. Other demographically-based differences could be expected, because of differences in resources, experiences and the like, but such differences are likely to be more situationally specific. In the present research, post-undergraduate education was found to be associated with less use of both problem- and emotion-focused techniques. Marital status and income together explained a significant percentage of variance when preference of one type of coping over another was the dependent variable, but no individual item of this set of variables was found to significantly predict coping strategy preference. These demographic variables are considered here as being simply background sources of variability.

One additional background variable that was found to be associated with styles of coping was self-reported need for control in general situations. Greater reported desire for control was positively associated with use of problem-focused techniques in dealing with the task and noise. Because problem-focused techniques are ordinarily intended to provide a way to gain control over one's environment, it can be expected that greater desire for control would lead

to greater attempts to secure that control in this manner. No relationship between desirability of control and use of emotion-focused strategies was noted.

Because the manipulations did not clearly result in predicted stress reactions and responses were variable, individual differences in perceptions and responses were analyzed to assess effects of demand and control on coping. Noise was interpreted as being uncontrollable on average but was not the only source of uncontrollable stress among the subjects. A number of subjects reported that their success at the task was also outside their control. Accordingly, in order to assess the effects of demand level crossed with perceptions of control within the same stressor, internal analyses entering perceptions of demand and perceptions of control over success at the task as predictors of coping responses were conducted.

As would be predicted from the hypotheses, self-reported controllability of success was positively related to preference for use of problem-focused techniques. This is consistent with other studies that have manipulated controllability of success and measured coping strategies (e.g., Sullivan & Weisse, 1990) and those that have assessed controllability of life stressors and related coping strategies to those (e.g., Folkman & Lazarus, 1980; Folkman et al., 1986; Torestad, Olah, & Magnusson, 1985). This finding is also consistent with previous reports of the importance of perceptions of control over actual control in

determining responses (e.g., Glass & Singer, 1972).

Self-reported ratings of demand were strongly correlated with other measures reflecting level of effort, interest, and upset associated with working on the task. The factor score created from these inter-related measures showed positive relationships with use of both emotion- and problem-focused techniques and the higher the levels of perceived demand and task-related upset, the greater the preference for use of emotion-focused strategies over problem-focused strategies. The strong relationship between demand and task-related upset may explain the greater preference for emotion-focused coping over problem-focused strategies when perceived demand was higher, but the lack of relationship between perceived demand and problem-focused strategies was not expected. This is contrary to what was predicted, since it had been assumed that "demand" would be perceived by subjects as reflecting a do-able challenge. Others have indicated that challenges show a combination of instrumental and emotional regulation (McCrae, 1984). While that may be the case, as has been discussed previously, challenges marked by too great difficulty can result in giving up (Light & Obrist, 1983), which could raise the need for emotional regulation and mitigate need for attempts to overcome the problem itself.

The interaction between perceived control over success and level of demand clarifies the relationship among these variables with coping strategies. When both

perceptions of demand and control are evaluated, it is noted that the ratio between use of emotion- and problem-focused techniques is more greatly affected by the level of demand when perceptions of control over success are low. Mostly, this interaction is accounted for by an increase in preference for emotion-focused strategies over problem-focused ones when demand is high and perceptions of control low. When control over the source of stress is low use of problem-focused techniques can be viewed as ineffective and emotion-regulation would be the more appropriate response (Vitaliano, DeWolfe, Maiuro, Russo & Katon, 1990). The pattern of responses shown here seem to follow that proposition.

A more objective measure of success, specifically the number of clients' forms that were completed by subjects, was also related to shifts in preference in coping. Again, extent of use of emotion-focused coping was significantly related to success, with greater use and preference for this style of coping over problem-focused strategies being evident when numbers of forms completed was smaller. The lack of relationship with use of problem-focused strategies indicates that the shift in preference toward was through increased use of emotion-focused strategies rather than any change in use problem-focused techniques. This pattern, along with the similar pattern noted when perceptions of success were low, indicates that in this type of short-term work setting being asked to

perform beyond what seems do-able results in more need of emotion-regulation without any appreciable shifts in efforts to address the problem itself. This was the case even though increased demand implicitly calls for greater effort to succeed, fitting a more planful or problem-oriented approach to gain success. In the present study, problem-focused strategies were only used when perceptions of control over success were high.

Another issue related to control and coping is whether only controllability affects the mode of coping taken or if the emotional responses to that event also play a role. This issue along with examination of whether coping responses to demand were additive to those responses associated with being exposed to uncontrollable, upsetting stimuli were addressed. In a set of internal analyses, perceptions of demand were crossed with levels of reported upset associated with noise exposure. Unlike perceptions of demand and control over success, reported upset due to the uncontrollable noise was not associated with coping strategies, however, greater perceived demand coupled with increased reported upset from the noise was associated with more strategies being used in total. Specifically, more emotion-focused strategies were used and in preference to problem-focused strategies when demand and noise-related upset were high. While high task demand and exposure to upsetting, uncontrollable noise led to the net outcome of greater numbers of coping strategies employed, confirming

the hypothesis, the content of those strategies are counter to prediction with only emotion-focused strategies being significantly affected.

Mood responses also predicted coping styles used and the patterns of relationships were consistent with the process nature of coping and stress (Lazarus & Folkman, 1984). That coping and stress are interacting processes suggests that one does not necessarily precede the other, but that they occur simultaneously with constant reappraisal of possible actions, actions taken, and reactions. The questionnaire given at the end of the task specifically requested subjects to identify which coping strategies were used during the task and noise exposure. Baseline mood clearly preceded coping strategies used in response to the task and noise, but it is not clear whether other relevant unmeasured factors preceded both mood and coping, limiting causal inferences. Greater limitations are placed on inferences drawn from mood measurements obtained during the mid-point of the task or the changes that occurred between baseline and mid-point because coping responses to the situation would have already been in progress.

In tests of mood effects on coping, greater levels of baseline stress were associated with greater use of emotion-focused strategies. Levels of stress measured at mid-point continued to be positively related to use of emotion-focused strategies, but no other mood factor at that time point was. The more that stress increased from

baseline to mid-point, the more that emotion-focused coping was reported as well.

Baseline helplessness predicted greater use of emotion-focused strategies and was also positively associated with a preference for emotion-focused strategies relative to problem-focused ones. However, the direction of change from baseline helplessness to mid-point measures of this factor were negatively associated with emotion-focused coping. Since baseline measures occurred prior to the situation for which coping was assessed, the finding that increased baseline helplessness was associated with increased use of emotion-focused coping can reasonably be interpreted as demonstrating that higher levels of helplessness led to increased use of emotion-focused strategies. The negative association of change in helplessness from baseline to mid-point with greater use of emotion-focused coping may be best explained as evidence that use of emotion-focused coping led to greater decreases in helplessness. Without time-sequenced measures, however, these interpretations must be considered cautiously.

No baseline mood factor was predictive of use of problem-focused strategies. Mid-point levels of irritation were negatively related to use of problem-focused coping whereas measures of lethargy and discomfort at the same time point were positively. Without significant baseline predictors for this coping factor, interpretation of these associations is not possible.

In the end, the strongest predictor of use of problem-focused strategies during the session was use of emotion-focused strategies. Likewise, use of problem-focused coping was the strongest predictor of emotion-focused coping. In each case, the style of coping entered as a predictor had been entered as the final step in the equation and accounted for nearly half of the remaining variance. This indicates that those that used one type of coping more tended to use other types of coping more as well, which is consistent with results of other studies (Lazarus & Folkman, 1984). The strength of the relationship between these two types of coping is likely a result of the measurement of these responses within the same questionnaire and reflects the intercorrelated nature of that instrument.

In summary, the relationships of control and demand with styles of coping used are somewhat contrary to prediction because feelings of control over success were only associated with greater use of problem-focused coping while increased demand level and decreased success outcome were only associated with greater use of emotion-focused strategies. The coping responses associated with noise-related upset, however, were consistent with the hypotheses in that greater upset when coupled with greater task demand was associated with more emotion-focused strategies being employed. Also, total number of coping strategies used, both problem- and emotion-focused strategies combined, were found to be positively related to desire for control,

perceived demand, and the noise-upset/perceived demand interaction. Predicted patterns of coping when high demand and low perceptions of control were combined were confirmed. The results were only somewhat consistent with the hypotheses in that high demand with low perceptions of control over success was associated with greatest preference for emotion-focused coping, as was high demand coupled with high levels of noise-related upset. However, high demand did not result in the predicted greater preference for problem-focused strategies, whether when control was perceived as high or not and regardless of level of upset attributed to noise.

Coffee consumption

It was hypothesized that coffee consumption would increase among habitual coffee drinkers under stressful situations. It was also hypothesized that, if increased coffee consumption occurred, it would be because coffee was being used either for instrumental and/or emotion-regulating purposes, therefore paralleling use of problem- and emotion-focused coping strategies, respectively. From that reasoning, coffee consumption was expected to be greatest among those required to perform at a higher level while being exposed to uncontrollable noise, and least among those with lower performance expectations and no noise exposure. Coffee consumption was also tested as a product of perceptions of demand and control and of coping styles

actually used.

The noise and demand manipulations themselves had no effect on coffee consumption in the lab, and so were not included in the final MRC models. Demographic variables accounted for a significant amount of the variance in both total volume of coffee left at the end of the session and for the estimated percent of normal intake that had been consumed during the session. Women had more coffee left at the end of the session, and this was unrelated to usual use patterns. Other demographic variables were varied in nature and appear to be generally more situationally relevant. People who had at least some undergraduate education had more coffee left at the end of the session; having had at least some undergraduate education was associated with a lesser percentage of usual coffee consumption being consumed in the laboratory and living with people other than relatives was associated with a greater percentage. Because no demographic variables had been hypothesized as having an impact on coffee consumption they were considered to be simply sources of background variability.

Other background variables had more relevant and predictable impacts on coffee consumption during the session. Those who had a higher level of daily coffee intake consumed a smaller percentage of that intake in the lab. Additionally, those who consumed more herbal tea during the session had more coffee left at the end of the session. Surprisingly, caffeine intake prior to arrival at

the lab had no significant effect on consumption during the session. Given the length of the study and the fact that it was conducted early in the morning, most subjects had not consumed their usual total daily amount of coffee prior to arrival, probably accounting for this lack of association in the present study. One further background variable of note, that will be discussed in more detail later in this chapter, was self-report of whether caffeine intake increases, decreases, or stays the same during stress. Self-reported increased use of caffeine under stress predicted greater coffee consumption in the lab, both by volume left and by percentage of usual intake.

Beyond the background and demographic variables, few items predicted coffee consumption during the session. The similarity of the structure of the break schedule and the beverages provided to those normally encountered by subjects were positively related to levels of coffee consumed. Further analysis of measures directly relevant to the hypothesis regarding the role of stress in coffee consumption were tested in the MRC analyses following each of the various background and manipulation-check items. These included task performance as measured by number of clients' forms completed and baseline and mid-point mood and the extent of change in between. Other measures reflecting perceptions of demand, perceptions of control over task success, and the level of upset caused by the uncontrollable noise were assessed in separate equations, each with

background and beverage-relevant items entered first.

Few feelings or moods predicted coffee consumption. Greater levels of reported helplessness at the mid-point rest period were positively related to percentage of normal intake consumed in the lab. Conversely, noise-related upset was negatively related to the percentage of normal coffee consumption consumed in the lab, indicating that subjects who were more upset by the noise consumed less of their usual amount of coffee than did those who were less upset. Perceptions of demand, perceptions of control over success, and their interaction were not predictive of either measure of coffee consumption nor was the combination of perceptions of demand with noise-related upset.

In addition to mood responses to stress, coping strategies as predictors of coffee consumption were of interest. Styles of coping, especially use of emotion-focused coping, was associated with a number of situational and person-centered variables. None of the variables showing associations with coping strategies significantly predicted coffee consumption except helplessness at mid-point, which had positively predicted coffee use. However, use of emotion-focused strategies, and the preference for that type of strategy, was associated with coffee consumption, with decreased total consumption and decreased proportions of consumption occurring when emotion-focused strategies were used more. Use of problem-focused strategies showed no association with coffee consumption

measures.

In summary, only two indicators of stress or emotional responses to the task or noise situations predicted coffee consumption, namely helplessness and level of upset related to the noise. Of those, only one, helplessness, was positively associated with increased coffee consumption. Both problem- and emotion-focused styles of coping were predicted to be associated with increased coffee consumption, but use of problem-focused strategies showed no significant relationship with consumption and use of emotion-focused strategies were negatively associated. In general, these results refute the hypotheses. However, a sub-group of subjects, making up 41% of the total sample, stated that their caffeine consumption generally increased during stress (IC). Internal analyses comparing these subjects to those who reported generally having no changes in consumption or decreases during stress (NC) resulted in findings more consistent with hypotheses, namely that, for the IC group, coffee consumption was greater when perceived stress was higher and this was related to use of problem-focused strategies of coping.

Those subjects who reported generally increasing caffeine consumption when under stress (IC) on average consumed more coffee during the session and drank a greater proportion of their normal daily intake than did NC. These consumption differences were not due to any differences between IC and NC groups on normal levels of consumption,

indicators of caffeine addiction, or use of caffeine prior to the study. Coffee consumption based on IC or NC designation was further differentiated when IC-NC groups were split on high or low mood responses. When reporting greater levels of helplessness or lethargy/discomfort, IC subjects consumed more coffee and a greater proportion of their usual intake, and NC subjects consumed less under the same conditions. Differences in consumption between IC and NC groups disappeared when low levels of helplessness and lethargy/discomfort were reported. Perceptions of task demand or controllability, or of how upsetting the noise was, did not interact with IC-NC groupings.

In analyses combining coping strategies used with the IC-NC groupings it was found that the number of different problem-focused strategies employed interacted with IC-NC in that those that claimed that caffeine intake increases during stress and used a larger number of problem-focused strategies consumed the largest amount of coffee; the ones who claimed no changes in consumption or a decrease and who used more problem-focused strategies consumed the smallest amount. For the IC sub-group, this last finding was consistent with the hypothesis that consumption of coffee would parallel use of problem-focused strategies.

For both IC and NC subjects, effects of coffee expected by subjects likely played a role in the consumption patterns observed under stressful conditions. When stress was reported to be low, patterns of consumption were similar

between the two groups, but differences clearly emerged when perceptions of stress were higher or when discomfort that could be related to either stress or withdrawal was noted. That greater use of coffee was found among the IC subjects that were also using more problem-focused approaches to coping is consistent with the hypothesized use of coffee for active stressor-reducing reasons, as opposed to palliation. Together, these findings indicate that a sub-group of coffee drinkers expect coffee to be helpful during stress and react accordingly by consuming more of it under those circumstances. Because the coffee used was decaffeinated, actual effects of caffeinated coffee cannot be determined from the current study.

Summary and conclusions

There is continuing controversy regarding coffee use as a risk factor for cardiovascular diseases (Grobbee et al., 1990; Klatsky, Friedman, & Armstrong, 1990; Puccio et al., 1990). One recent shift has been the study of caffeine intake in combination with acute stressors to monitor physiological reactions. Studies using this methodology have noted that the effects of caffeine and stress on the body are similar, and that the two combined result in cardiovascular responses that are generally at least additive to one another (e.g., Lane et al., 1990; Lane & Williams, 1985, 1987; Myers et al., 1989; Pincomb et al., 1987; Ratliff-Crain, O'Keeffe, & Baum, 1989; Strickland et

al., 1989). While there is evidence that suggests that coffee is consumed in greater amounts during stress, the evidence is almost exclusively anecdotal in nature without careful controls or measurement (e.g., Conway et al., 1981). The primary evidence stems from reports suggesting that a growing percentage of daily coffee intake is consumed at work (International Coffee Organization, 1982, 1989), and one study in which coffee consumption was shown to be positively correlated with systematic increases in work-stress (Conway et al., 1981).

Studies examining the effects of caffeine in combination with stress have predominantly used acute stressors or challenging tasks even though various types of stressful situations exist that may be conducive to caffeine use, such as situations requiring long work times, moonlighting, or meeting deadlines. Caffeine has been shown to have effects useful in acute, challenging situations because of increased alertness, perseverance, and so on (Gilliland & Bullock, 1984; Hollingsworth, 1912; Regina et al., 1974). It was then reasonable to predict that moderate to heavy coffee drinkers as a group would increase coffee consumption under stressful conditions. Accordingly, the present study tested unrestricted consumption in a controlled setting during a lengthy, although acute, challenging task. For the general subject sample, however, coffee consumption did not increase in response to demands where caffeine's stimulatory effects would have been useful.

Following from this, it was hypothesized that consumption would be found to parallel use of emotion- or problem-focused coping responses. These hypotheses provide the possibility that coffee, as a source of caffeine, would be used by coffee drinkers as a group for certain coping purposes. Caffeine's stimulatory effects, if resulting in greater work efficiency and longevity, has likely problem-focused uses. However, levels of demand placed on subjects in the form of increased work requirements failed to result in increased changes in consumption. Previous research has also shown that coffee has palliative functions for habitual users (Goldstein, Kaizer & Whitby, 1969; Ratliff-Crain, O'Keeffe & Baum, 1989; O'Keeffe, 1991), but coffee consumption was inconsistently used for apparent emotional regulation in the present study. Increased levels of reported helplessness predicted increased consumption, however use of emotion-focused strategies of coping was associated with decreased consumption, as were negative moods.

Therefore, the results presented thus far suggest that when moderate to heavy coffee drinkers were considered as a group greater use of emotion-focused coping was associated with decreased consumption of coffee and the only general, stress-related response associated with increased consumption were feelings of helplessness. However, as with alcohol, another drug used for a variety of reasons by a large proportion of the population, person-situation

interactions appear to play a role in patterns of coffee consumption during stress (Ratliff-Crain, 1989). Some evidence of these interactions affecting consumption of coffee were noted when those subjects who claimed to use caffeine more when under stress were compared with those who claimed no change or decreased consumption under those circumstances. For example, those who generally increase use under stress who used a larger number of problem-focused strategies consumed a greater volume of coffee. Additionally, increased coffee consumption was found when greater lethargy and discomfort occurred among those subjects who generally increase caffeine intake under stress.

Expectations of coffee's effects may play an important role in determining consumption patterns. Endorsement of more of the stimulatory effects of caffeine either as expected outcomes or as reasons for consumption have been identified as predictors of heavier caffeine use and more caffeine-related problems such as caffeinism (Bradley & Petree, 1990; Graham, 1987). This suggests a parallel with the alcohol literature where it has been reported that positive expectations of alcohol's effects are associated with greater use of the drug (Leigh, 1989). More germane to the present study is the finding that greater expectations of alcohol being a useful coping strategy have been positively associated with development of abusive drinking patterns (Cooper, Russell & George, 1988).

In sum, the results revealed that coffee consumption is predominantly affected by background variables and daily habits, at least in the type of acute stress setting used in the present study. When changes in consumption were found in response to stress, the person-situation interactions influenced whether coffee intake increased or decreased. To date, whether a link exists between coffee and negative health outcomes has remained controversial. Individual differences in patterns of intake may provide some clue to the connection. Those that tend to increase consumption during stress in particular need to be examined more carefully in terms of their physiological and emotional responses to stress when caffeinated coffee is available and in their expectations of coffee's effects. Relatedly, people responding to stress by decreasing coffee consumption may be circumventing whatever health risks exist by reducing intake.

It should be noted that those subjects who reported consuming less caffeine under stress were no different from those who reported increasing consumption under stress in daily consumption of coffee, history of use, or in apparent susceptability to withdrawal symptoms upon discontinuation of use. Without accounting for when and how coffee is consumed, the relative risk associated with coffee use between these two groups appears similar when, in fact, it may not be.

Of more basic interest to the study of stress and

coping, the present study also evaluated coping strategies in response to a lengthy laboratory stressor. This study expands on the available research regarding perceived controllability of stressors and strategies of coping employed by exposing subjects to limited, controlled conditions for which coping behaviors were to be identified. Predominantly, the research on perceived control and coping has relied on subjects' responses regarding stressors that had occurred in their daily lives. In those cases, options of responses may be differentially determined by circumstances, the person's role, and so on. In the present laboratory environment, the same responses were available for all participants and levels of demand and noise exposure were manipulated. The study also afforded a limited, consistent coping time period, allowing for lower variability due to memory or varying shifts in coping which would occur otherwise.

Person-situation interactions influenced coping responses. Having control or not was found to only significantly affect use of problem-focused strategies, with general desire for control also being predictive of use of this type of coping, potentially as a means of gaining control. On the other hand, levels of demand and negative emotional responses were predictive of emotion-focused coping only. The results indicated that exposure to an uncontrollable situation itself did not instigate use of emotion-focused coping, but led to increased use of this

style of coping only if the situation resulted in negative mood. Therefore, controllability seems to have more direct effects on problem-focused coping, with indirect effects on emotion-focused coping being mediated by mood responses.

In conclusion, coffee consumption in the laboratory was affected predominantly by individual background factors, such as normal daily consumption, and use of emotion-focused coping strategies which was predictive of decreased coffee consumption. Person-situation interactions further determined coffee consumption during the study. For example, those subjects who reported generally increasing caffeine consumption during stress consumed more coffee and a greater proportion of their normal intake when also reporting more negative mood or reporting use of more problem-focused coping strategies. Others tended to decrease use under those conditions. These findings indicate that use of caffeine during stress varies based on individual patterns of consumption that can be assessed and may likely relate to expectations of effects. Clearly, epidemiological studies need to incorporate patterns of use in assessment of relative risk associated with caffeine intake.

Coping strategies used were also found to be a product of both personal and situational variables. Greater desire for control and perceptions of task controllability were predictive of greater use of problem-focused strategies, whereas emotional responses were predictive of

use of emotion-focused strategies. These findings indicate that decisions to use problem-focused techniques to cope with acute stressors of the type used in this study are directly tied to perceptions of and motivations for control whereas use of emotion-focused coping is affected by control only in as much as controllability affects mood.

1 To calculate the approximate ratio of ml coffee consumed in the laboratory to self-reported normal consumption, it was necessary to estimate coffee consumed during the session. This proved to be difficult because of evaporation occurring during brewing and during the three hours that the coffee urns were heating. Four subjects reported drinking no coffee during the session and so their volume consumed was listed as 0 (zero). For the 47 subjects who consumed no herbal tea during the session, volume of coffee consumed was calculated as the volume left in the coffee urn subtracted from the volume left in the herbal tea urn. Measurements indicated that the amount of fluid loss in both urns were comparable over time. For the remaining subjects who consumed both tea and coffee during the session, the volume left in the coffee urn was subtracted from the average tea volume left when no tea had been consumed (mean = 954 ml., s.d. = 16.88).

2 Degrees of freedom reported for analyses over time reflect Greenhouse-Geisser adjusted degrees of freedom. Error degrees of freedom = 118 for mood by time analyses without adjustment.

TABLE 1-A

RESULTS OF FACTOR ANALYSES:
FEELINGS AND MOODS FORM

Factor 1: "Irritated"
Eigenvalue = 9.41, % variance = 14.9, Cronbach's alpha = .87

Variable	Avg. Loading
Angry	.50
Need aspirin	.51
Need something to jazz you up	.31
Headache	.44
Irritated	.46
Want a cigarette	-.63

Factor 2: "Stressed"
Eigenvalue = 8.56, % variance = 13.6, Cronbach's alpha = .87

Variable	Avg. Loading
Comfortable	-.30
Sad	-.26
Upset stomach	.40
Restless	.52
Stressed	.74
Trouble concentrating	.63

Factor 3: "Lethargy/discomfort"
Eigenvalue = 5.39, % variance = 8.6, Cronbach's alpha = .88

Variable	Avg. Loading
Need aspirin	.40
Down	.55
Need something to jazz you up	.58
Upset stomach	.48
Headache	.27
Lethargic	.66

Factor 4: "Helpless"
Eigenvalue = 4.98, % variance = 7.9, Cronbach's alpha = .77

Variable	Avg. Loading
Irritated	-.26
Overwhelmed	.48
Helpless	.79

Factor 5: "Comfort"
Eigenvalue = 4.31, % variance = 6.8, Cronbach's alpha = .87

Variable	Avg. Loading
Comfortable	.62
Happy	.84
Calm	.40

TABLE 1-B

RESULTS OF FACTOR ANALYSES:
TASK/NOISE PERCEPTION FORM

Factor 1: "Task demand/upset"
Eigenvalue = 2.7, % variance = 33.7

Variable	Loading
Effort put into the task	.53
How upsetting the noise was	.31
How upsetting the task was	.67
How successful performance at the task was	-.45
How hard needed to work to succeed	.85
How demanding the task was	.80
How boring the task was	-.50

TABLE 2. Mean rankings on a scale from 1 (Not at all) to 7(Extremely) for task and noise perceptions, high versus low demand conditions. * = $p < .05$; ** = $p < .01$; *** = $p < .001$

TABLE 2

TASK AND NOISE PERCEPTIONS:
High vs. Low Demand

	HI (n=31)	LOW (n=32)
How much effort did you put into the task?	6.23	6.28
How upsetting did you find the noise?	3.00	2.63
How loud did you think the noise was?	3.10	2.96
How upsetting did you find the task?	4.58	3.35**
How successful do you feel you were at performing the task?	3.26	3.88
How much control did you have over stopping the noise?	1.19	1.91*
How hard did you feel that you had to work to succeed at the task?	5.94	5.38*
How demanding did you find the task?	5.84	4.66***
How much control did you have over succeeding at the task?	5.06	4.63
How bored did the task make you?	2.87	2.88

TABLE 3. Total mood scores at each measurement point for entire sample. Baseline was scored from 0 (not at all) to 4 (extremely) with mid-point scores being the sum of the baseline and the responses to the questionnaire given during the third rest period, scored from -2 (very much less [than previous time]) to +2 (very much more [than previous time]). End-point questions were phrased identically to those given at mid-point, but were given immediately following the fifth task period. End-point scores represent the sum of these last questions and the total mid-point score (baseline + mid-point). Like-superscripts are significantly different at $p < .05$

TABLE 3

CHANGES IN MOOD OVER THE DURATION OF THE TASK

MOOD FACTOR	BASELINE	MID-POINT	END-POINT
Irritation	4.72	4.89	5.02
Stressed	6.95[ab]	8.48[a]	8.95[b]
Lethargy/discomfort	.92	.53	.27
Helplessness	4.54	4.73[c]	4.25[c]
Comfort	7.06[de]	6.06[d]	5.98[e]

TABLE 4. Mean task and noise perceptions by subjects in the low demand condition compared with expected levels of 1 ("not at all") and the mid-point of the scale that ranged from 1 ("not at all") to 7 ("extremely"). Differences from 7 were only calculated if "extremely" could be expected from a low demand situation. * = $p < .05$; ** = $p < .01$; -- = not calculated.

TABLE 4

T-TEST COMPARISONS OF MEAN RESPONSES TO TASK PERCEPTION ITEMS BY THE LOW DEMAND GROUP TO EXPECTED MEANS OF 1, 4, OR 7

Item	Mean	t-scores compared to possible answers: 1	4	7
How much effort did you put into the task?	6.28	33.1**	14.3**	--
How upsetting did you find the task?	3.35	6.8**	ns	--
How sucessful do you feel you were at performing the task?	3.88	11.6**	ns	-12.56**
How hard did you feel that you had to work to succeed at the task?	5.38	25.86**	8.13**	--
How demanding did you find the task?	4.66	15.84**	2.84**	--
How much control did you have over succeeding at the task?	4.63	13.67**	2.35*	--
How bored did the task make you?	2.88	5.32**	-3.19**	-11.7**

TABLE 5. Mean rankings on a scale from 1 (Not at all) to 7(Extremely) for task and noise perceptions, high versus low noise conditions. * = $p < .05$; ** = $p < .01$; *** = $p < .001$

TABLE 5

TASK AND NOISE PERCEPTIONS:
High vs. Low Noise

	HI (n=31)	LOW (n=32)
How much effort did you put into the task?	6.31	6.19
How upsetting did you find the noise?	3.91	1.68***
How loud did you think the noise was?	4.41	1.61***
How upsetting did you find the task?	4.44	3.47*
How successful do you feel you were at performing the task?	3.63	3.52
How much control did you have over stopping the noise?	1.84	1.26
How hard did you feel that you had to work to succeed at the task?	5.72	5.58
How demanding did you find the task?	5.38	5.10
How much control did you have over succeeding at the task?	4.66	5.03
How bored did the task make you?	2.81	2.94

TABLE 6. Total mood scores at each time point for high versus low noise conditions. Baseline was scored from 0 (not at all) to 4 (extremely) with mid-point scores being the sum of the baseline and the responses to the questionnaire given during the third rest period, scored from -2 (very much less [than previous time]) to +2 (very much more [than previous time]). End-point questions were phrased identically to those given at mid-point, but were given immediately following the fifth task period. End-point scores represent the sum of these last questions and the total mid-point score (baseline + mid-point). Like superscripts are significantly different at $p < .05$. ** = $p < .01$

TABLE 6

IRRITATION: EFFECTS OF NOISE AND NOISE OVER TIME

	High	Low
Overall means, high vs. low noise:	5.80	3.95**
Total mood ratings over time:		
BASELINE	4.91	4.53[a]
MID-POINT	5.94[d,e]	3.84[b,d]
END-POINT	6.56[a,b,c]	3.47[c,e]

LETHARGY/DISCOMFORT: EFFECTS OF NOISE AND NOISE OVER TIME

	High	Low
Overall means, high vs. low noise:	1.56	-0.19**
Total mood ratings over time:		
BASELINE	.94[a]	1.16[b]
MID-POINT	-.29[c,e]	1.59[c,d]
END-POINT	-1.16[abdf]	1.94[e,f]

TABLE 7. Heart rate changes from baseline in beats per minute for entire sample. Like-superscripts are significantly different at $p < .05$

TABLE 7

HEART RATE CHANGES OVER TIME

TASK SEGMENT	MEASUREMENT PERIOD WITHIN TASK SEGMENT 1-min.	2-min.	5-min.	15-min.	MEAN
1	2.60	2.57	2.55	3.60	2.83[cef]
2	0.75	2.12	1.77	1.12	1.44[bd]
3	-0.72	-0.03	0.87	0.67	0.20[af]
4	-2.15	-1.32	-0.63	-0.80	-1.23[de]
5	-3.22	-2.28	-1.62	-1.15	-2.07[abc]

TABLE 8a-b. Total mood scores at each time point. Baseline was scored from 0 (not at all) to 4 (extremely) with mid-point scores being the sum of the baseline and the responses given during the third rest period, scored from -2 (very much less [than previous time]) to +2 (very much more [than previous time]). End-point scores represent the sum of the questions given at the end and the total mid-point score (baseline + mid-point). Like-superscripts are significantly different at $p < .05$.

TABLE 8a. Sample sizes for each group, created from median splits of questions, "How demanding did you find the task?" and "How much control did you have over succeeding at the task?": LPD/LPC = 14, LPD/HPC = 23, HPD/LPC = 9, HPD/HPC = 17. ANOVA for the four groups made up of low/high perceived demand crossed with low/high levels of perceived control over time on levels of comfort was significant, however unplanned comparisons of means failed to reach significance on any comparison.

TABLE 8b. Sample sizes for each group, created from median splits of the question, "How upsetting was the noise?": Low upset = 35, High upset = 28. For the interaction with perceived demand, LPD/LU = 20, LPD/HU = 15, HPD/LU = 17, HPD/HU = 11. ANOVA for the four groups made up of low/high perceived demand crossed with low/high levels of noise-related upset on levels of comfort was significant, however unplanned comparisons of means failed to reach significance on any comparison.

TABLE 8a

PERCEIVED DEMAND/PERCEPTIONS OF CONTROL OVER SUCCESS

CHANGES IN LEVELS OF IRRITATION OVER TIME

	Baseline	Mid-pt.	End-pt.	Mean
Low perceived demand				
Low perceived control	4.71[h]	4.14[e]	3.64[ad]	4.17
High perceived control	4.83[f]	5.00[c]	5.30	5.04
High perceived demand				
Low perceived control	5.22	6.56	7.89[(a-h)]	6.56
High perceived control	4.35[g]	4.53[d]	4.29[b]	4.39

CHANGES IN LEVELS OF COMFORT OVER TIME

	Baseline	Mid-pt.	End-pt.	Mean
Low perceived demand				
Low perceived control	6.93	5.79	5.29	6.00
High perceived control	7.61	7.22	7.52	7.45
High perceived demand				
Low perceived control	6.89	5.78	5.78	6.15
High perceived control	6.53	4.88	4.47	5.29

TABLE 8b

HOW UPSETTING WAS NOISE

CHANGES IN LEVELS OF IRRITATION OVER TIME

	Baseline	Mid-pt.	End-pt.	Mean
Low noise upset	4.60^{a}	4.03^{cf}	3.69^{de}	4.11^{x}
High noise upset	4.89^{b}	6.00^{ef}	6.71^{a-d}	5.87^{x}

CHANGES IN LEVELS OF STRESS OVER TIME

	Baseline	Mid-pt.	End-pt.	Mean
Low noise upset	7.00^{a}	8.46	8.23	7.90
High noise upset	6.89^{b}	8.50	9.86^{ab}	8.42

CHANGES IN LEVELS OF LETHARGY/DISCOMFORT OVER TIME

	Baseline	Mid-pt.	End-pt.	Mean
Low noise upset	0.94	-0.12^{ac}	-0.80^{bde}	0.007^{x}
High noise upset	1.18^{e}	1.64^{cd}	1.93^{ab}	1.58^{x}

INTERACTION OF PERCEIVED DEMAND
WITH HOW UPSETTING THE NOISE WAS

LEVELS OF COMFORT

	Low perceived demand	High perceived demand
Low noise upset	6.62	6.31
High noise upset	7.24	4.61

TABLE 9. Heart rate changes from baseline in beats per minute, averaged across the four measurement times within task segment, among groups created from median splits of questions, "How demanding did you find the task?" and "How much control did you have over succeeding at the task?".

Like-superscripts are significantly different at $p < .05$

TABLE 9

PERCEIVED DEMAND/PERCEPTIONS OF CONTROL OVER SUCCESS:
HEART RATE CHANGES FROM BASELINE

		TASK SEGMENT				
Group	(N)	1	2	3	4	5
LD/LC	(13)	1.85[ab]	1.83	-0.21	-2.96[a]	-3.63[b]
LD/HC	(22)	3.54[cd]	2.39	1.49	-0.85[c]	-0.46[d]
HD/LC	(9)	3.33[efg]	0.42	-1.25[e]	-1.78[f]	-4.00[g]
HD/HC	(15)	2.23[h]	0.05	-0.97	-1.50	-2.38[h]

TABLE 10a. Results of MRC analyses, total emotion-focused coping score from the Ways of Coping scale as dependent variable, with proportion of variance (R^2) for each set of independent variables (I through VI) and their significance levels, in the order of entry. Each variable in each set follows in the order of entry with R^2 shown for each variable and the regression coefficient (B) and significance shown for variables belonging to significant sets. ns = $p > .05$.

TABLE 10b. Results of baseline mood and the extent of mood change from baseline to mid-point when entered as alternative sets of independent variables at step V of the MRC equation. Steps I to IV were identical to those reported in Table 10a.

TABLE 10a

RESULTS OF MRC ANALYSIS WITH
EMOTION-FOCUSED COPING AS DEPENDENT VARIABLE

		B	$\triangle R^2$	Sig
I.	BACKGROUND		.14	< .01
	Post-undergraduate education	-15.16	.14	< .01
II.	DESIRE FOR CONTROL		.04	ns
	Desire for control			.04
III.	GENERAL TASK PERCEPTIONS		.08	ns
	Controllability of success		< .01	
	Compar. of task to normal work		.05	
IV.	TASK PERFORMANCE/ PERCEIVED DEMAND		.14	< .01
	Number of clients completed	-7.01	.09	< .01
	Task demand/upset	.56	.04	.055
V.	MID-POINT MOOD FACTORS		.20	< .01
	Irritated		.02	ns
	Stressed	1.96	.11	< .01
	Lethargy/discomfort		.02	ns
	Helplessness		< .01	ns
	Comfort		< .01	ns
VI.	COPING STRATEGIES		.18	< .001
	Problem-focused	.99	.18	< .001

TABLE 10b

RESULTS OF MRC ANALYSIS WITH
EMOTION-FOCUSED COPING AS DEPENDENT VARIABLE
Alternative Mood Measurements for Step V

		B	ΔR^2	Sig
V.	BASELINE MOOD FACTORS		.20	< .01
	Irritated		< .01	ns
	Stressed	2.27	.05	.01
	Lethargy/discomfort		.02	ns
	Helplessness	6.54	.03	.054
	Comfort		.01	

		B	ΔR^2	Sig
V.	EXTENT OF MOOD CHANGE FROM BASELINE TO MID-POINT		.17	< .01
	Irritated		.02	ns
	Stressed	2.16	.04	.03
	Lethargy/discomfort		< .01	ns
	Helplessness	- .97	.04	.04
	Comfort		< .01	ns

TABLE 11a. Results of MRC analyses, total problem-focused coping score from the Ways of Coping scale as dependent variable, with proportion of variance (R^2) for each set of independent variables (I through VI) and their significance levels, in the order of entry. Each variable in each set follows in the order of entry with R^2 shown for each variable and the regression coefficient (B) and significance shown for variables belonging to significant sets. ns = $p > .05$.

TABLE 11b. Results of baseline mood and the extent of mood change from baseline to mid-point when entered as alternative sets of independent variables at step V of the MRC equation. Steps I to IV were identical to those reported in Table 11a.

TABLE 11a

RESULTS OF MRC ANALYSIS WITH
PROBLEM-FOCUSED COPING AS DEPENDENT VARIABLE

		B	$\triangle R^2$	Sig
I.	BACKGROUND		.14	< .01
	Post-undergraduate education	- 9.24	.14	< .01
II.	DESIRE FOR CONTROL		.09	.01
	Desire for control	.35	.09	.01
III.	GENERAL TASK PERCEPTIONS		.04	ns
	Controllability of success		< .01	ns
	Compar. of task to normal work		.04	ns
IV.	TASK PERFORMANCE/ PERCEIVED DEMAND		.10	.02
	Number of clients completed		.04	ns
	Task demand/upset	.38	.05	.03
V.	MID-POINT MOOD FACTORS		.12	.05
	Irritated	- .87	.06	.02
	Stressed		.04	ns
	Lethargy/discomfort	5.05	.06	.02
	Helplessness		< .01	ns
	Comfort		< .01	ns
VI.	COPING STRATEGIES		.23	< .001
	Emotion-focused	.46	.23	< .001

TABLE 11b

RESULTS OF MRC ANALYSIS WITH
PROBLEM-FOCUSED COPING AS DEPENDENT VARIABLE
Alternative Mood Measurements for Step V

		B	ΔR^2	Sig
V.	BASELINE MOOD FACTORS		.10	ns
	Irritated		< .01	
	Stressed		.01	
	Lethargy/discomfort		.04	
	Helplessness		.01	
	Comfort		< .01	

		B	ΔR^2	Sig
V.	EXTENT OF MOOD CHANGE FROM BASELINE TO MID-POINT		.11	ns
	Irritated		.06	
	Stressed		.03	
	Lethargy/discomfort		< .01	
	Helplessness		.02	
	Comfort		< .01	

TABLE 12a. Results of MRC analyses, ratio of total emotion-focused coping score to total problem-focused coping score from the Ways of Coping scale as dependent variable, with proportion of variance (R^2) for each set of independent variables (I through V) and their significance levels, in the order of entry. Each variable in each set follows in the order of entry with R^2 shown for each variable and the regression coefficient (B) and significance shown for variables belonging to significant sets. ns = $p > .05$.

TABLE 12b. Results of baseline mood and the extent of mood change from baseline to mid-point when entered as alternative sets of independent variables at step V of the MRC equation. Steps I to IV were identical to those reported in Table 12a.

TABLE 12a

RESULTS OF MRC ANALYSIS WITH
EMOTION/PROBLEM COPING RATIO AS DEPENDENT VARIABLE

		B	$\triangle R^2$	Sig
I.	BACKGROUND		.16	.03
	Being single		< .01	ns
	Being widowed		.05	ns
	Earning < $10,000		.01	ns
	Earning $20-30,000		.02	ns
II.	DESIRE FOR CONTROL		< .01	ns
	Desire for control			< .01
III.	GENERAL TASK PERCEPTIONS		.08	.056
	Controllability of success	- .09	.06	.03
	Compar. of task to normal work	- .09	.06	.03
IV.	TASK PERFORMANCE/ PERCEIVED DEMAND		.14	< .01
	Number of clients completed	-7.01	.09	< .01
	Task demand/upset	.56	.04	.055
V.	MID-POINT MOOD FACTORS		.05	ns
	Irritated		< .01	
	Stressed		.01	
	Lethargy/discomfort		< .01	
	Helplessness		.01	
	Comfort		< .01	

TABLE 12b

RESULTS OF MRC ANALYSIS WITH
EMOTION/PROBLEM COPING RATIO AS DEPENDENT VARIABLE
Alternative Mood Measurements for Step V

		B	ΔR^2	Sig
V.	BASELINE MOOD FACTORS		.13	.03
	Irritated		< .01	ns
	Stressed		< .01	ns
	Lethargy/discomfort		< .01	ns
	Helplessness	.40	.09	< .01
	Comfort		< .01	ns

		B	ΔR^2	Sig
V.	EXTENT OF MOOD CHANGE FROM BASELINE TO MID-POINT		.06	ns
	Irritated		< .01	
	Stressed		< .01	
	Lethargy/discomfort		.02	
	Helplessness		.01	
	Comfort		< .01	

TABLE 13. Results of MRC analyses, total number of coping strategies endorsed as dependent variable, with proportion of variance (R^2) for each set of independent variables (I through IV) and their significance levels, in the order of entry. Each variable in each set follows in the order of entry with R^2 shown for each variable and the regression coefficient (B) and significance shown for variables belonging to significant sets. Note that sets IIIa and IVa (perceived demand, perceived control over success, and their interaction) were entered into analyses separately from IIIb and IVb (perceived demand, reported noise-related upset, and their interaction). ns = $p > .05$.

TABLE 13

RESULTS OF MRC ANALYSIS WITH NUMBER OF COPING ITEMS MARKED AS BEING USED AS DEPENDENT VARIABLE

		B	ΔR^2	Sig
I.	BACKGROUND		.22	< .001
	Post-undergraduate	- 5.1	.13	.01
	Home ownership	-10.5	.06	.05
II.	DESIRE FOR CONTROL		.05	< .05
	Usual daily intake	.30	.05	< .05
IIIa.	TASK-RELATED PERCEPTIONS		.09	< .05
	Perceptions of demand	2.28	.09	< .01
	Perceptions of control over success		< .01	ns
IVa.	PERCEPTION INTERACTION		< .01	ns
	Perception of demand X perception of control		< .01	
IIIb.	TASK AND NOISE PERCEPTIONS		.11	< .01
	Perceptions of demand	2.23	.08	< .01
	Noise-related upset		.02	ns
IVb.	PERCEPTION INTERACTION		.05	.03
	Perception of demand X perception of control	.92	.05	.03

TABLE 14a. Results of MRC analyses, total volume of coffee left in the urn at the end of the session as dependent variable, with proportion of variance (R^2) for each set of independent variables (I through VII) and their significance levels, in the order of entry. Each variable in each set follows in the order of entry with R^2 shown for each variable and the regression coefficient (B) and significance shown for variables belonging to significant sets. Note that sets VIIa and VIIb were entered into separate analyses and represent entry following set VI (mid-point mood). ns = $p > .05$.

TABLE 14b. Results of baseline mood and the extent of mood change from baseline to mid-point when entered as alternative sets of independent variables at step VI of the MRC equation. Steps I to V were identical to those reported in Table 14a.

TABLE 14a

RESULTS OF MRC ANALYSIS WITH
COFFEE LEFT IN URN AS DEPENDENT VARIABLE-I

		B	ΔR^2	Sig
I.	BACKGROUND		.17	< .01
	Attended college	124.2	.09	.01
	Gender	70.5	.05	.05
II.	COFFEE USE PATTERNS		.12	< .01
	Usual daily intake		.04	ns
	Use of caffeine under stress	- 58.8	.08	.01
III.	OTHER BEVERAGE INTAKE DAY OF STUDY		.08	.04
	Caffeine prior to study		< .01	ns
	Herbal tea intake during study	- .52	.08	.01
IV.	COMPARABILITY OF BREAK/ BEVERAGES TO NORM.		.09	.01
	Breaks	- 24.7	.05	.02
	Beverages	- 23.9	.05	.02
V.	NUMBER OF CLIENTS COMP.		.02	ns
	Number completed		.02	
VI.	MID-POINT MOOD FACTORS		.02	ns
	Lethargy/discomfort		< .01	
	Helplessness		.02	
VIIa.	COPING STRATEGIES		.06	.05
	Problem-focused		< .01	ns
	Emotion-focused	3.76	.04	.04
VIIb.	COPING STRATEGIES		.05	.02
	E/P ratio	77.93	.05	.02

TABLE 14b

RESULTS OF MRC ANALYSIS WITH
COFFEE LEFT IN URN AS DEPENDENT VARIABLE-I
Alternative Mood Measurements for Step VI

		B	ΔR^2	Sig
VI.	BASELINE MOOD FACTORS		< .01	ns
	Lethargy/discomfort		< .01	
	Helplessness		< .01	

		B	ΔR^2	Sig
VI.	EXTENT OF MOOD CHANGE FROM BASELINE TO MID-POINT		.02	ns
	Lethargy/discomfort		< .01	
	Helplessness		< .01	

TABLE 15. Results of MRC analyses, total volume of coffee left in the urn at the end of the session as dependent variable, with proportion of variance (R^2) for each set of independent variables (I through IV) and their significance levels, in the order of entry. Each variable in each set follows in the order of entry with R^2 shown for each variable and the regression coefficient (B) and significance shown for variables belonging to significant sets. Note that sets IIIa and IVa (perceived demand, perceived control over success, and their interaction) were entered into analyses separately from IIIb and IVb (perceived demand, reported noise-related upset, and their interaction). ns = $p > .05$.

TABLE 15

RESULTS OF MRC ANALYSIS WITH
COFFEE LEFT IN URN AS DEPENDENT VARIABLE-II

		B	$\triangle R^2$	Sig
I.	BACKGROUND		.17	< .01
	Attended college	125.2	.09	.01
	Gender	70.5	.05	.05
II.	CAFFEINE INTAKE FACTORS		.14	< .05
	Usual daily intake	-14.2	.06	.03
	Caffeine prior to study		.01	ns
	Herbal tea intake during study	- .52	.08	.01
IIIa.	TASK-RELATED PERCEPTIONS		.04	ns
	Perceptions of demand		.01	
	Perceptions of control over success		.03	
IVa.	PERCEPTION INTERACTION		< .01	ns
	Perception of demand X perception of control		< .01	
IIIb.	TASK AND NOISE PERCEPTIONS		.03	ns
	Perceptions of demand		.02	
	Noise-related upset		.01	
IVb.	PERCEPTION INTERACTION		< .01	ns
	Perception of demand X noise-related upset		< .01	

TABLE 16a. Results of MRC analyses, ratio of estimated volume of coffee consumed during the session to self-reported daily coffee consumption as dependent variable, with proportion of variance (R^2) for each set of independent variables (I through VII) and their significance levels, in the order of entry. Each variable in each set follows in the order of entry with R^2 shown for each variable and the regression coefficient (B) and significance shown for variables belonging to significant sets. Note that sets VIIa and VIIb were entered into separate analyses and represent entry following set VI (mid-point mood). ns = $p > .05$.

TABLE 16b. Results of baseline mood and the extent of mood change from baseline to mid-point when entered as alternative sets of independent variables at step VI of the MRC equation. Steps I to V were identical to those reported in Table 16a.

TABLE 16a
RESULTS OF MRC ANALYSIS WITH
COFFEE CONSUMPTION RATIO AS DEPENDENT VARIABLE-I

		B	$\triangle R^2$	Sig
I.	BACKGROUND		.26	< .01
	Live w/ other than relatives	.08	.05	.05
	Attended college	- .09	.06	.04
	Rural	- .05	.03	ns
	# family w/in 30 miles	< .01	.02	ns
II.	COFFEE USE PATTERNS		.12	< .01
	Usual daily intake	- .01	.07	.03
	Use of caffeine under stress	.04	.07	.01
III.	OTHER BEVERAGE INTAKE DAY OF STUDY		.05	ns
	Caffeine prior to study		.01	
	Herbal tea intake during study		.04	
IV.	COMPARABILITY OF BREAK/ BEVERAGES TO NORM.		.06	.047
	Breaks		.02	ns
	Beverages	.02	.05	.03
V.	TASK PERFORMANCE		.01	ns
	Number of clients completed		.01	
VI.	MID-POINT MOOD FACTORS		.06	.04
	Lethargy/discomfort		< .01	ns
	Helplessness	.08	.06	.01
VIIa.	COPING STRATEGIES		.05	.04
	Problem-focused		< .01	ns
	Emotion-focused	- .003	.04	.03
VIIb.	COPING STRATEGIES		.05	.02
	E/P ratio	- .07	.05	.02

TABLE 16b
RESULTS OF MRC ANALYSIS WITH
COFFEE CONSUMPTION RATIO AS DEPENDENT VARIABLE-I
Alternative Mood Measurements for Step VI

	B	$\triangle R^2$	Sig
VI. BASELINE MOOD FACTORS		< .01	ns
Lethargy/discomfort		< .01	
Helplessness		< .01	

	B	$\triangle R^2$	Sig
VI. EXTENT OF MOOD CHANGE FROM BASELINE TO MID-POINT		.04	ns
Lethargy/discomfort		< .01	
Helplessness		.03	

TABLE 17. Results of MRC analyses, ratio of estimated volume of coffee consumed during the session to self-reported daily coffee consumption as dependent variable, with proportion of variance (R^2) for each set of independent variables (I through VII) and their significance levels, in the order of entry. Each variable in each set follows in the order of entry with R^2 shown for each variable and the regression coefficient (B) and significance shown for variables belonging to significant sets. Note that sets IIIa and IVa (perceived demand, perceived control over success, and their interaction) were entered into analyses separately from IIIb and IVb (perceived demand, reported noise-related upset, and their interaction). ns = $p > .05$.

TABLE 17

RESULTS OF MRC ANALYSIS WITH
COFFEE CONSUMPTION RATIO AS DEPENDENT VARIABLE-II

		B	$\triangle R^2$	Sig
I.	BACKGROUND		.17	< .01
	Attended college	124.2	.09	.01
	Gender	70.5	.05	.05
II.	CAFFEINE INTAKE FACTORS		.14	< .05
	Usual daily intake	-14.2	.06	.03
	Caffeine prior to study		.01	ns
	Herbal tea intake during study	- .52	.08	.01
IIIa.	TASK-RELATED PERCEPTIONS		.06	ns
	Perceptions of demand		.05	
	Perceptions of control over success		< .01	
IVa.	PERCEPTION INTERACTION		.03	ns
	Perception of demand X perception of control		.03	
IIIb.	TASK AND NOISE PERCEPTIONS		.08	< .05
	Perceptions of demand		.03	ns
	Noise-related upset	- .01	.04	< .05
IVb.	PERCEPTION INTERACTION		< .01	ns
	Perception of demand X noise-related upset		< .01	

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
F. EDWARD HÉBERT SCHOOL OF MEDICINE
4301 JONES BRIDGE ROAD
BETHESDA, MARYLAND 20814-4799

MEDICAL PSYCHOLOGY

TEACHING HOSPITALS
WALTER REED ARMY MEDICAL CENTER
NAVAL HOSPITAL BETHESDA
MALCOLM GROW AIR FORCE MEDICAL CENTER
WILFORD HALL AIR FORCE MEDICAL CENTER

CONSENT FOR RESEARCH PARTICIPATION

Please read carefully.

For several years, we have been studying how living in urban areas affects the way people behave. The study that you are being asked to participate in is a part of this research program. In this study, we are interested in how different aspects of the office environment can affect worker productivity and mood. Accordingly, we will ask you to perform a task that is similar to typical office work. You may find the task, which is similar to filling out Federal tax forms, difficult or frustrating but "do-able". Additionally, there will be distractions similar to those that may be encountered in an office setting, including noise. If noise is presented to you, it will be played over headphones at a volume not to exceed 95dBA, which is loud enough to be distracting without causing any harm. Noise will only be played intermittently. Another feature of the study similar to office work will be various pay rates and periodic coffee-breaks. The total time of the session will be less than two hours.

During each session you will be asked to complete some questionnaires about your feelings, mood, health, and so on. The questions are routine and generally found to be unobjectionable. Additionally, several times during the session we will measure distal blood flow using a non-invasive ear clip. This device works simply by measuring the amount of light passed through your earlobe and should not cause any discomfort. We also will ask you to provide three urine samples, one collected on the morning of the laboratory visit and the other two at the beginning and end of the laboratory session. These samples will only be used to measure naturally occurring levels of cortisol present in the urine. It is important that we get complete data on every subject and that you complete the session, but you are free to end the session at any time without penalty. Your identity will not be traceable by anyone other than the principal investigator. When you have completed the session, or withdrawn, your name will be deleted from all records and no one will be able to trace your data. The data will not be reported in any way that would allow anyone to identify you.

If you decide to participate in this study, you will be paid $10.00 for arriving at the laboratory and will receive up to $15.00 additionally for work on the task, giving a total of up to $25.00. This compensation is for the time that you spend in the study.

If you have any questions during the study, we expect you to ask us. If you have any additional questions, feel free to call the principal investigator (Dr. Andrew Baum) at the Medical Psychology Department at (301) 295-3270. He will be happy to answer any questions or concerns that you may have.

If you believe that you have suffered any injury or illness as a result of participating in this research, please contact the office of grants management, (202) 295-3303, at the University. This office can review the matter with you and may may be able to identify resources available to you. Information about judicial avenues of compensation is available from the University's Legal Counsel, (202) 295-3028.

(Next page please)

YOU ARE MAKING A DECISION TO PARTICIPATE IN THIS STUDY

Your signature indicates that you have read the information provided and that you agree to participate.

I AGREE TO PARTICIPATE IN THIS PROJECT:
I certify that I have received a copy of this consent form:

_____
Subject Initials

Date Signed_____

_____ _____
Full Name (Signed) Full Name (Printed)

_____
Social Security #

_____ _____
Witness (Signed) Witness Name/Rank/SS#

_____ _____
Investigator/Designee Signature Investigator/Designee Name/Rank/SS#

(Note: All of the above information MUST be filled out)

UNIVERSITY OF MINNESOTA
MORRIS

Division of the Social Sciences
Morris, Minnesota 56267

CONSENT FOR RESEARCH PARTICIPATION

Please read carefully.

For several years, we have been studying how living in urban areas affects the way people behave. The study that you are being asked to participate in is a part of this research program. In this study, we are interested in how different aspects of the office environment can affect worker productivity and mood. Accordingly, we will ask you to perform a task that is similar to typical office work. You may find the task, which is similar to filling out Federal tax forms, difficult or frustrating but "do-able". Additionally, there will be distractions similar to those that may be encountered in an office setting, including noise. If noise is presented to you, it will be played over headphones at a volume not to exceed 95dBA, which is loud enough to be distracting without causing any harm. Noise will only be played intermittently. Another feature of the study similar to office work will be various pay rates and periodic coffee-breaks. The total time of the session will be less than three hours.

During each session you will be asked to complete some questionnaires about your feelings, mood, health, and so on. The questions are routine and generally found to be unobjectionable. Additionally, several times during the session we will measure distal blood flow using a non-invasive ear clip. This device works simply by measuring the amount of light passed through your earlobe and should not cause any discomfort. We also will ask you to provide three urine samples, one collected on the morning of the laboratory visit and the other two at the beginning and end of the laboratory session. These samples will only be used to measure naturally occurring levels of cortisol present in the urine.

Your decision whether to participate will not affect your future relations with the University of Minnesota in any way. If you decide to participate, you are free to discontinue participation at any time without affecting such relationships. Your identity will not be traceable by anyone other than the principal investigator. When you have completed the session, or withdrawn, your name will be deleted from all records and no one will be able to trace your data. The data will not be reported in any way that would allow anyone to identify you.

If you decide to participate in this study, you will be given $10 as compensation for arriving at the laboratory and will receive up to $15.00 for work on the task. This compensation is for the time that you spend in the study.

Please ask if any questions arise during the study. If you have any additional questions about the research and/or subjects' rights or wish to report a research-related injury, please call Jeff Ratliff-Crain at the Social Sciences Division office at (612) 589-2211, ext. 6220.

(Next page please)

APPENDIX B
BACKGROUND DATA

1. How would you characterize where you live now:
   _____ Rural Community
   _____ Small Town
   _____ Suburban Neighborhood
   _____ Urban Neighborhood
   _____ Other (Specify)

2. How long have you lived at your present residence? _____

3. What is your marital status?
   _____ Single
   _____ Single, living with significant other _____ How long?
   _____ Separated _____ How long?
   _____ Divorced _____ How long?
   _____ Widowed _____ How long?

4. If you were previously married, how long were you married?_____

5. Number of family members living within 30 miles _____

6. Your highest educational level:
   _____ Grammar School
   _____ High School
   _____ Some College
   _____ College Degree
   _____ Graduate Work
   _____ Other (specify) _____

7. Number of people living at your residence _____

   b) Are any of these people anything other than relatives?
   yes_____ no _____

8. Number of rooms in your residence _____

9. Type of residence:
   _____ Apartment
   _____ Single family home
   _____ Two family home
   _____ Three family home
   _____ Townhouse
   _____ Other (specify) _____

10. Do you own or rent? _____

11. How long have you lived at your present address? _____

12. List your primary reasons for selecting this place to live (e.g., close to schools, close to work, etc.) _____
    _____
    _____

13. Approximate annual income:

_____ Under $10,000/year
_____ $10,000 - $15,000/year
_____ $15,001 - $20,000/year
_____ $20,001 - $30,000/year
_____ $30,001 - $40,000/year
_____ $40,001 - $50,000/year
_____ over $50,000/year

14. Your occupation (including student, homemaker, etc.) _____

15. Average number of hours you work
per day _____
per week _____

16. What is your usual work schedule? (e.g. 9am to 5pm; 7am-3pm/ 3pm-11pm rotate; no fixed hours; etc.) _____

17. Are you: (circle one)

male female

18. Your age _____

Below you will find a series of statements. Please read each statement carefully and respond to it by expressing the extent to which you believe the statement applies to you. For all items a response from 1 to 7 is required. Use the number that best reflects your belief when the scale is defined as follows.

1. The statement doesn't apply to me at all.
2. The statement doesn't apply to me.
3. Most often the statement does not apply.
4. I am unsure about whether or not the statement applies to me, or it applies to me about half the time.
5. The statement applies more often than not.
6. The statement usually applies to me.
7. The statement always applies to me.

It is important that you respond to all items.

1. When I go out with other people I usually make most of the arrangements.

1 2 3 4 5 6 7

2. I am comfortable lending my possessions (e.g., books and records) to my friends.

1 2 3 4 5 6 7

3. If I am going to an event (a lecture or movie) which I expect will be crowded, I try to arrive early.

1 2 3 4 5 6 7

4. I almost never get things done until the last minute.

1 2 3 4 5 6 7

5. I like to gamble and play games of chance.

1 2 3 4 5 6 7

6. I would rather play an individual sport such as tennis than a team sport such as basketball.

1 2 3 4 5 6 7

7. I would prefer to get on a subway or bus early and have a longer ride but a choice of where to sit than to have a shorter ride and less choice.

1 2 3 4 5 6 7

8. I don't mind other people scheduling my time.

1 2 3 4 5 6 7

9. I really get a kick out of driving a very responsive car.

1 2 3 4 5 6 7

10. I think it would be fun to be hypnotized.

1 2 3 4 5 6 7

11. I like to get high on alcohol or drugs.

1 2 3 4 5 6 7

12. I usually push an elevator button even if it is lighted indicating that someone has already pushed it.

1 2 3 4 5 6 7

13. I enjoy political participation because I want to have as much say in running the government as possible.

1 2 3 4 5 6 7

14. When driving I try to avoid putting myself in a situation where I could be hurt by someone else's mistake.

1 2 3 4 5 6 7

15. I would prefer to be a leader rather than a follower.

1 2 3 4 5 6 7

16. I enjoy making my own decisions.

1 2 3 4 5 6 7

Instructions:

For the following questions, read each item and mark how much you are experiencing that feeling or mood now ("Not at all" to "Extremely"). Please check only one choice for each item. It is important that you answer every question.

	Not at all	A little bit	Moderately	Quite a bit	Extremely
Angry					
That you'd like an aspirin or other pain reliever					
Comfortable					
Nervous or shaky					
That you'd like something to calm you down					
Depressed/Sad					
That you'd like something to "jazz you up"					
Happy					
That things are out of your control					
That your stomach is upset					
Restless					
That you have a headache					
Stressed					
That you're having trouble concentrating					
Irritable					
That you'd like a cup of coffee					
Overwhelmed					
That you'd like a cigarette					
Lethargic					
Calm					
Helpless					

(B)

Instructions:

Compared to when you filled out the previous mood questionnaire, how much do you now feel...

	Very much less	Less	Same	More	Very much more
Angry					
That you'd like an aspirin or other pain reliever					
Comfortable					
Nervous or shaky					
That you'd like something to calm you down					
Depressed/Sad					
That you'd like something to "jazz you up"					
Happy					
That things are out of your control					
That your stomach is upset					
Restless					
That you have a headache					
Stressed					
That you're having trouble concentrating					
Irritable					
That you'd like a cup of coffee					
Overwhelmed					
That you'd like a cigarette					
Lethargic					
Calm					
Helpless					

(C)

Instructions:

Compared to when you filled out the previous mood questionnaire, how much do you now feel...

	Very much less	Less	Same	More	Very much more
Angry					
That you'd like an aspirin or other pain reliever					
Comfortable					
Nervous or shaky					
That you'd like something to calm you down					
Depressed/Sad					
That you'd like something to "jazz you up"					
Happy					
That things are out of your control					
That your stomach is upset					
Restless					
That you have a headache					
Stressed					
That you're having trouble concentrating					
Irritable					
That you'd like a cup of coffee					
Overwhelmed					
That you'd like a cigarette					
Lethargic					
Calm					
Helpless					

Directions: Please circle the number between 1 and 7 that most accurately describes your feelings.

1. How much effort did you put into the task?

1	2	3	4	5	6	7
None at all						A lot

2. How upsetting did you find the noise?

1	2	3	4	5	6	7
Not at all						Extremely

3. How loud did you think the noise was?

1	2	3	4	5	6	7
Not at all						Extremely

4. How upsetting did you find the task?

1	2	3	4	5	6	7
Not at all						Extremely

5. How successful do you feel you were at performing the task?

1	2	3	4	5	6	7
Not at all						Extremely

6. How much control did you have over stopping the noise?

1	2	3	4	5	6	7
None at all						A lot

7. How hard did you feel that you had to work to succeed at the task?

1	2	3	4	5	6	7
Not at all						Extremely

8. How demanding did you find the task?

1	2	3	4	5	6	7
Not at all						Extremely

9. How much control did you have over succeeding at the task?

1	2	3	4	5	6	7
None at all						A lot

10. How bored did the task make you?

1	2	3	4	5	6	7
Not at all						Extremely

The following is a list of possible ways of dealing with a stressful situation. Each of the thoughts or behaviors listed may be like the ways in which people feel and behave when they experience stress. Please think about the experimental situation (<u>office task and noise</u>). We are interested in the degree to which you felt or used each of the thoughts or behaviors described in these items to deal with this situation. Please check the appropriate column to indicate whether the thought or behavior was one that you: Never used or felt; Rarely used or felt; Sometimes used or felt; or Regularly used or felt.

THOUGHTS/BEHAVIORS	never used	rarely used	sometimes used	regularly used
1. Bargained or compromised to get something positive from the situation.				
2. Talked to someone to find out about the situation.				
3. Blamed yourself.				
4. Concentrated on something good that could come out of the whole thing.				
5. Criticized or lectured yourself.				
6. Tried not to burn my bridges behind me, but left things open somewhat.				
7. Hoped a miracle would happen.				
8. Asked someone I respected for advice and followed it.				
9. Kept others from knowing how bad things were.				
10. Talked to someone about how I was feeling.				
11. Stood my ground and fought for what I wanted.				
12. Just took things one step at a time.				
13. I knew what had to be done, so I doubled my efforts and tried harder to make things work.				

THOUGHTS/BEHAVIORS	never used	rarely used	sometimes used	regularly used
14. Refused to believe that it had happened.				
15. Came up with a couple of different solutions to the problem.				
16. Wished I were a stronger person--more optimistic and forceful.				
17. Accepted my strong feelings, but didn't let them interfere with other things too much.				
18. Wished that I could change what had happened.				
19. Wished that I could change the way that I felt.				
20. Changed someting about myself so that I could deal with the situation better.				
21. Daydreamed or imagined a better time or place than the one I was in.				
22. Had fantasies or wished about how things might turn out.				
23. Thought about fantastic or unreal things (like the perfect revenge or finding a million dollars) that made me feel better.				
24. Wished that the situation would go away or somehow be finished.				
25. Went on as if nothing had happened.				
26. Felt bad that I couldn't avoid the problem.				
27. Kept my feelings to myself.				
28. Slept more than usual.				
29. Got mad at the people or things that caused the problem.				
30. Accepted sympathy and understanding from someone.				

THOUGHTS/BEHAVIORS	never used	rarely used	sometimes used	regularly used
31. Tried to forget the whole thing.				
32. Got professional help and did what they recommended.				
33. Changed or grew as a person in a good way.				
34. Made a plan of action and followed it.				
35. Accepted the next best thing that I wanted.				
36. Realized that you brought the problem on yourself.				
37. Came out of the experience better than when I went in.				
38. Talked to someone who could do something concrete about the problem.				
39. Tried to make myself feel better by eating, drinking, smoking, taking medication, etc.				
40. Tried not to act too hastily or follow my own hunch.				
41. Changed something so things would turn out all right.				
42. Avoided being with people in general.				

S#_____

In the spaces provided below, please list out all of the foods and/or beverages that you have had since you woke up this morning. For example, if you had a bowl of cereal with milk and a glass of juice, you would fill out the spaces provided like this:

TIME	ITEM	APPROX. AMOUNT
8:45	cereal w/ milk	1 bowl
8:45	orange juice	8oz. glass

Ask the experimenter if you have any questions.

TIME	ITEM	APPROX. AMOUNT

In the space below, please describe what you feel was the purpose of this study. Include any additional comments that you may have about the study as well.

We are interested in how the environment that we have set up in this study compares to the average office envronment. The following questions will ask you to compare different parts of this study with your current working environment. If your working environment does not include the aspect that is to be compared, make the comparison to how you would imagine it to be in a typical office setting.

1. How did the task compare with your normal work:

1	2	3	4	5	6	7
Very different						Exactly the same

2. How did the noise level compare to noise levels experienced at work:

1	2	3	4	5	6	7
Very different						Exactly the same

3. How did the work/break schedule compare to your normal schedule:

1	2	3	4	5	6	7
Very different						Exactly the same

4. How did the refreshments provided at the break compare with food and beverages normally available at breaks:

1	2	3	4	5	6	7
Very different						Exactly the same

5. How did the coffee provided compare with your normal coffee:

   A. Taste--

1	2	3	4	5	6	7
Very different						Exactly the same

   B. Caffeine content--

1	2	3	4	5	6	7
Very much less						Very much more

Inventory C

Do you currently drink coffee? ____ Yes ____ No

Age began drinking coffee _____

Average number of 8oz cups of coffee per day _____

Have you ever quit, or tried to quit, drinking coffee? ____ Yes ____ No
If yes, why? (e.g. health, "nerves", stomach problems, etc.) _____

_____

If you quit, reason for resuming coffee drinking _____

What type of coffee do you usually drink? (Check ONE)
_____ Instant coffee (caffeinated)
_____ Brewed coffee-- perked (caffeinated)
_____ Brewed coffee-- fresh drip (caffeinated)
_____ Decaffeinated coffee-- brewed or instant (e.g. Sanka, Brim)

If you were to drink a strong cup of coffee shortly before bedtime, would it be likely to interfere with your falling asleep?
_____ Yes _____ No _____ Don't know

If you were to omit drinking coffee in the morning, how often would it be you would develop a headache?
_____ Almost always
_____ Usually
_____ Seldom
_____ Never
_____ Don't know

On the average, list how many cups of coffee (e.g. 0, 1, 2 ...) you drink at the following times:
_____ Before breakfast
_____ With breakfast or immediately after
_____ Between breakfast and lunchtime
_____ With lunch
_____ Between lunch and dinner
_____ With dinner
_____ After dinner

Do you currently drink tea? _____ Yes _____ No

Average number of 8oz cups of tea per day _____

What type of tea do you usually drink? (Check ONE)
_____ Leaf tea (hot/cold)
_____ Bagged tea (hot/cold)
_____ Instant tea (hot/cold)
_____ Herb tea
_____ Other (please specify)

On the average, how much cola or soda do you drink? (e.g., Coca-Cola, Pepsi, Mountain Dew, Dr. Pepper, Tab, etc.)?

_____ I never drink it
_____ One can or bottle per week or less
_____ 2-6 cans or bottles per week
_____ 1-3 cans or bottles per day
_____ 4-6 cans or bottles per day
_____ 7 or more cans or bottles per day

What type or brand of soda do you usually drink? _____

During an average week, how many pain medications do you take (e.g., aspirin, Tylenol, Midol, etc.) _____

What type or brand of pain medication do you usually take? _____

During an average week, how many cold or allergy tablets do you take? _____

What brand or type of cold or allergy tablet do you take? _____

During an average week, how many of the following stimulants or diet pills do you take? (If none, please fill all of the blanks in with zeros).

_____ Tablets/week No-Doz
_____ Tablets/week Caffedrine
_____ Tablets/week Vivarin
_____ Tablets/week Prolamine
_____ Tablets/week Appedrine
_____ Tablets/week other (please specify _____)

When you are experiencing stress st home, school, or on the job (extra work, financial worries, arguments, etc.), how does the stress affect your use of caffeine (coffee, tea, etc.)?

_____ My caffeine intake greatly increases
_____ My caffeine intake increases
_____ My caffeine intake remains the same
_____ My caffeine intake decreases
_____ My caffeine intake greatly decreases
_____ I have no caffeine intake

Screening procedure:

"I need to ask you some questions to see if you are eligible for the study. This is a standard screening form that we use, so some questions may not be related to the study that you are interested in. NOTE: All answers are confidential and you are not required to answer any questions that you don't want to"

Date _____

1. Name _____
2. Address _____

   _____

   _____
3. Phone (Day) _____ (Eve) _____
4. Age _____ 5. Gender M / F
6. Are you now or have you recently been under a doctor's care? (Y/N)
   If yes, why _____
7. Do you take any kinds of medication regularly? (Y / N)
   What kinds _____
8. Non-prescription drugs: _____
9. Are you taking any steroids or using any steroid creams (such as Cortaid?)
10. Are you visually impaired? Y / N
11. Do you have any of the following health problems:
    Asthma _____
    Diabetes _____
    Heart condition (specify) _____
    High blood pressure _____
    Seizure disorder _____
    Ulcer _____
    Thyroid problems _____
    Liver problems (e.g., hepatitis, cirhosis) _____
    Other (specify) _____
11. Do you smoke cigarettes? _____ # per day _____
12. How many alcoholic drinks do you have per week? _____
13. How many cups of coffee per day? _____
    Other caffeinated beverages _____

DEBRIEFING PROTOCOL

1a. How did you feel about the task?

b. How challenging did you find the task?

Not at all moderately very

c. How many forms did you predict that you'd complete?

d. You completed how many?

2a. How much money did you predict you'd earn when you arrived at the session today? _____ ** answer should be $25, if different, ask why.

b. How about once the task had begun? _____

3a. Let me ask you some more questions, if I may. Notice the two urns, one with coffee, the other with herbal tea. Why do you think they were here?

We would like to measure how much coffee you drank. Would that be o.k.?

YES / NO (have subject initial decision) _____

APPENDIX C

Task instructions and task

The following pages will be useful for the completion of the task, so please read them carefully.

Your job is to evaluate the way in which our clients use their income and to project for them how much the same style of living will cost after retirement. Budget information is provided about your clients in the "IN" basket on the desk. Use this information to complete the forms.

Instructions for completing the money usage evaluation form:

1. Complete the Family Income Statement from the information provided. Be sure to calculate the sub-totals and totals for each section.

2. On the Money Usage Evaluation form, compare your clients spending habits with those of the national average by calculating what percentage of their income they spend on the various types of expenditures. Enter the percentages into the spaces provided.

3. Calculate how much of their income your clients can use to invest. Use the figures that you calculated on the Family Income Statement.

4. To calculate the amount of income needed for the first five years of retirement, first find the estimated time until retirement noted on the information sheets and write that down on the Evaluation sheet. Next, find the appropriate inflation factor for the number of years from now until retirement from the inflation impact table on the next page. Now multiply each <u>living expense</u> listed by that factor. For example, if the client is four years from retirement now, each living expense should be multiplied by 1.3107. Enter each of those projected expences into the table under the heading of "Cost 1st year of retirement".

Next, do the same for five years into retirement. For example, if retirement is four years from now, use the inflation factor for nine years from now to calculate what your client will need at that time. In this case, each living expense would be multiplied by 1.8380. List these in the second column under the heading of "5th year of retirement". Remember to add up the totals.

Good luck with your work.

Inflation Impact Table

End of year	Inflation factor	End of year	Inflation factor
1	1.0700	16	2.9546
2	1.1449	17	3.1611
3	1.2250	18	3.3823
4	1.3107	19	3.6191
5	1.4024	20	3.8724
6	1.5005	21	4.1434
7	1.6055	22	4.4334
8	1.7178	23	4.7437
9	1.8380	24	5.0757
10	1.9666	25	5.4310
11	2.1042	26	5.8112
12	2.2514	27	6.2179
13	2.4117	28	6.6532
14	2.5805	29	7.1189
15	2.7611	30	7.6172

Tips for completing task correctly:

1. Calculate percentages like this--
   If the client spends $1500.00 per year on travel and makes $30000.00 per year, the percentage of the income spent would be calculated by dividing the amount spent by the amount made and then multiplying that number by 100.
   For example:
   1500 / 30000 = .05; .05 x 100 = 5 percent

2. Be sure to add all items together that should be (e.g., travel, entertainment, etc.).

3. Be careful to consider the time left on a loan when calculating money needed for retirement.

Client Number _____

Marital status _____

Number of dependents _____

==========

Family Income Statement
(based on most recent year)

Income

Salaries (after taxes)

A. Client $_____
B. Client's spouse (if married) _____
C. Others in household _____
D. Other income _____

Total salaries $ _____

Investment Income

E. Interest _____
F. Dividends _____
G. Real Estate _____
H. Other investment income _____

Total investment income $ _____

Total Income = $ _____

Expenses and Fixed Obligations

Living Expenses (per year)

A. Mortgage/rent payments $ _____
B. Utilities _____
C. Food _____
D. Clothing _____
E. Entertainment, travel, etc. _____
F. Transportation _____
G. Medical _____
H. Miscellaneous _____

Total living expenses $ _____

Insurance Premiums (payments over one year)

I. Life insurance _____
J. Health insurance _____
K. Property & liability insurance _____

Total insurance premiums $ _____

Current Liabilities

L. Charge accounts, credit card charges, and other bills payable (total due) $_____

M. Installment credit or short-term loans (total due) _____

N. Bank loans (e.g., car loan) (amt. paid per year)

_____

Number of years left of loan _____

Total liabilities = $ _____

Total expenses and fixed obligations = $ _____

Client Number _____

==========

Money Usage Evaluation

How spending habits compare with national averages:

	Percent Income	Average Percent Income
A. Mortgage/rent payments	_____	20-30%
B. Utilities	_____	5-7
C. Food	_____	10-15
D. Clothing	_____	5-10
E. Entertainment & travel	_____	6-14
F. Transportation	_____	6-10
G. Medical	_____	2-20
H. Insurance	_____	2-5
I. Debt and credit	_____	12-17
J. Savings and investments	_____	5-10
K. Miscellaneous/other	_____	13-19

Balance available for discretionary investment:

	Total income	_____
-	Total expenses & fixed obligations	_____
		_____

Income needed for first five years of retirement based on current expenditures and figured at 7% inflation rate:

Estimated time until retirement _____ years.

	Cost 1st year of retirement	5th year of retirement
A. Mortgage/rent payments	_____	_____
B. Utilities	_____	_____
C. Food	_____	_____
D. Clothing	_____	_____
E. Entertainment, etc.	_____	_____
F. Transportation	_____	_____
G. Medical	_____	_____
H. Insurance	_____	_____
I. Debt and credit	_____	_____
J. Savings and investments	_____	_____
K. Miscellaneous/other	_____	_____
Totals	_____	_____

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